

REPORT DOCUMENTATION PAGE**Form Approved**
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Service, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington, DC 20503.

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE (DD-MM-YYYY) 22-03-2011		2. REPORT TYPE Master of Military Studies Research Paper		3. DATES COVERED (From - To) September 2010 - April 2011	
4. TITLE AND SUBTITLE The Infernal Machine: The use of Improvised Explosive Devices (IED) against U.S. Forces				5a. CONTRACT NUMBER N/A	
				5b. GRANT NUMBER N/A	
				5c. PROGRAM ELEMENT NUMBER N/A	
6. AUTHOR(S) Mr. Jason A. Litowitz				5d. PROJECT NUMBER N/A	
				5e. TASK NUMBER N/A	
				5f. WORK UNIT NUMBER N/A	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) USMC Command and Staff College Marine Corps University 2076 South Street Quantico, VA 22134-5068				8. PERFORMING ORGANIZATION REPORT NUMBER N/A	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A				10. SPONSOR/MONITOR'S ACRONYM(S) N/A	
				11. SPONSORING/MONITORING AGENCY REPORT NUMBER N/A	
12. DISTRIBUTION AVAILABILITY STATEMENT Unlimited					
13. SUPPLEMENTARY NOTES N/A					
14. ABSTRACT The use of IEDs against U.S. military forces did not begin during Operations Enduring (OEF) and Iraqi Freedom (OIF). Instead, both unconventional and conventional military forces engaged the U.S. military with IEDs in nearly every major since the U.S. Civil War. Many of the devices and their associated tactics, techniques and procedures (TTPs) for construction, placement and use encountered by the U.S. military and its allies during OEF and OIF are similar to IEDs used throughout the last 150 years. The popularity that IEDs gained during OEF and OIF has the potential to become a transnational threat utilized against both the U.S. military and domestic targets. IEDs enable smaller, less equipped forces to level the playing field against larger, adversarial forces. Insurgents and terrorists within Afghanistan and Iraq demonstrated the effectiveness of IEDs. The military should expect future conflicts would include the use of IEDs. The U.S. military must continue to research technologies, develop training, and create doctrine designed to address the IED threats of the future.					
15. SUBJECT TERMS IED, VBIED, JIEDDO, CWIED, RCIED, Terrorist, Insurgent, Iraq, Afghanistan					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 47	19a. NAME OF RESPONSIBLE PERSON Marine Corps University / Command and Staff College
a. REPORT Unclass	b. ABSTRACT Unclass	c. THIS PAGE Unclass			19b. TELEPHONE NUMBER (Include area code) (703) 784-3330 (Admin Office)

*United States Marine Corps
Command and Staff College
Marine Corps University
2076 South Street
Marine Corps Combat Development Command
Quantico, Virginia 22134-5068*

MASTER OF MILITARY STUDIES

TITLE:

The Infernal Machine:
The use of Improvised Explosive Devices (IED) against U.S. Forces

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF MILITARY STUDIES

AUTHOR:

Mr. Jason A. Litowitz

AY10-11

Mentor and Oral Defense Committee Member: Eric Shibuya, PhD

Approved: X

Date: 18 MARCH 2011

Oral Defense Committee Member: Jonathan Phillips, PhD

Approved: X

Date: 18 March 2011

Terms and Acronyms

AAIED Anti-Armor IED

BATFE Bureau of Alcohol Tobacco Firearms and Explosives

CIED Counter IED

CWIED Command Wire IED

DoD Department of Defense

ECM Electronic Countermeasures

EFP Explosively Formed Penetrator

EOD Explosive Ordnance Disposal

GTD Global Terrorism Database

IC Intelligence Community

IED Improvised Explosive Device

IIS Iraqi Intelligence Services

IRA Irish Republican Army

JIEDDO Joint IED Defeat Organization

KIA Killed In Action

MCIA Marine Corps Intelligence Activity

MRAP Mine Resistant Ambush Protected Vehicle

MMS Masters of Military Studies

NATO North Atlantic Treaty Organization

NCTC National Counter Terrorism Center

NVA North Vietnamese Army

OEF Operation Enduring Freedom

OIF Operation Iraqi Freedom

PTTF Powder Train Time Fuze

RCIED Radio Controlled IED

SVBIED Suicide Vehicle Borne IED

TTP Tactics Techniques and Procedures

USA United States of America

U.S. United States

VC Vietcong

VOIED Victim Operated IED

WIA Wounded In Action

WTI Weapons Technical Intelligence

March 13, 2011

Executive Summary

Title: The Infernal Machine: The use of Improvised Explosive Devices (IEDs) against U.S. Forces

Author: Mr. Jason A. Litowitz, Marine Corps University, Command and Staff College

Thesis: The use of IEDs against U.S. military forces did not begin during Operations Enduring (OEF) and Iraqi Freedom (OIF). Instead, both unconventional and conventional military forces engaged the U.S. military with IEDs in nearly every major conflict since the U.S. Civil War. Many of the devices and their associated tactics, techniques and procedures (TTPs) for construction, placement and use encountered by the U.S. military and its allies during OEF and OIF are similar to IEDs used throughout the last 150 years. The popularity that IEDs gained during OEF and OIF has the potential to become a transnational threat utilized against both the U.S. military and domestic targets.

Discussion: The recent use of IEDs against the U.S. and its allies demonstrate how effective, easy to acquire and easy to assemble these devices are. None of the previous conflicts the U.S. military participated in experienced such enormous use of IEDs with damaging effects on equipment, troops and morale. As insurgents and terrorists throughout the world continue to be successful conducting IED operations, the notoriety associated with IEDs will continue to grow and encourage others to mimic these attacks.

Conclusion: IEDs enable smaller, less equipped forces to level the playing field against larger, adversarial forces. Insurgents and terrorists within Afghanistan and Iraq demonstrated the effectiveness of IEDs. The military should expect future conflicts would include the use of IEDs. The U.S. military must continue to research technologies, develop training, and create doctrine designed to address the IED threats of the future.

DISCLAIMER

THE OPINIONS AND CONCLUSIONS EXPRESSED HEREIN ARE THOSE OF THE INDIVIDUAL STUDENT AUTHOR AND DO NOT NECESSARILY REPRESENT THE VIEWS OF EITHER THE MARINE CORPS COMMAND AND STAFF COLLEGE OR ANY OTHER GOVERNMENT AGENCY, REFERENCES TO THIS STUDY SHOULD INCLUDE THE FOREGOING STATEMENT.

QUOTATION FROM, ABSTRACTION FROM, OR REPRODUCTION OF ALL OR ANY PART OF THIS DOCUMENT IS PERMITTED PROVIDED PROPER ACKNOWLEDGEMENT IS MADE.

Illustrations

	Page
Figure 1. 2009 Primary Methods used In Attack.....	29
Figure 2. 2009 Deaths by Method of Attack.....	30
Figure 3. 2009 Injuries by Weapons used in Attacks.....	31
Figure 4. Backpack Containing Explosive Device	32
Figure 5. Steel pipe in Main Charge Assembly.....	32
Figure 6. Lead Fishing Weights Coated with Rat Poison.....	33
Figure 7. Steel Pot Containing Four Modified 8 pound Artillery Projectile / CWIED Device....	34
Figure 8. Discovery of Infernal Machines and Control Room at Fort Columbus KY 1862.....	34
Figure 9. Horological Clockwork Mechanism for John Maxwells Time Delay IED.....	35
Figure 10. John Maxwells Disguised Time Delay IED.....	35
Figure 11. Destruction of Wharf in City Point VA, August 9, 1864.....	36
Figure 12. Courtena Coal Torpedo Diagram.....	37
Figure 13. Photograph of a Recovered Courtena Coal Torpedo.....	37
Figure 14. German Mannequin IED World War I.....	38
Figure 15. Royal Engineers Working on an Improvised Electrically Initiated Mine.....	38
Figure 16. German IED Emplacement Techniques of WWII.....	39
Figure 17. VC / NVA Pressure Plate Activated Electrically Initiated VOIED.....	40
Figure 18. Iraqi IED Statistics June 2003 - October 2005.....	41
Figure 19. Iraqi IED Statistics November 2005 - March 2008.....	42
Figure 20. Iraqi IED statistics April 2008 - May 2010.....	43
Figure 21. Afghanistan IED Statistics from FY 2003 – FY 2009.....	44
Figure 22. Afghanistan Pressure Cooker IED Container.....	44
Figure 23. Afghanistan VOIED Pressure Plate.....	45

Figure 24. JIEDDO FY 2006 – FY 2010 CIED Spending.....	46
Figure 25. EFP Emplaced for Roadside Attack.....	47

Table of Contents

	Page
List of Acronyms.....	ii
Executive Summary.....	iv
Disclaimer.....	v
List of Illustrations.....	vi
Preface.....	ix
Introduction.....	1
Lack of an Acceptable Definition.....	1
WTI IED Lexicon IED Definition.....	2
Background on IEDs.....	2
A Tool for Leveling the Playing Field.....	4
Impacts of IED Attacks.....	4
Strategic Impacts of IED Attacks.....	4
Tactical Impacts of IED Attacks.....	5
Psychological Impacts of IEDs on U.S. Military Operations.....	5
Global IED Statistics.....	6
IED Threats to the USA.....	7
Use of IEDs in American Conflicts.....	8
Confederate IED Designs.....	8
Confederate IED sabotage Techniques.....	9
Confederate IED Targeting Practices.....	10
World War I.....	10
World War II.....	11
Vietnam.....	12
Post September 11 TH 2001 (Iraq and Afghanistan).....	12
Iraq: “The Challenge Project”.....	13
IED Casualty Data for Iraq.....	14
Afghanistan.....	14
Not the Same as Before.....	15
JIEDDO CIED Efforts.....	16
Future IED Threat.....	17
Future Complexity of IED use and Construction.....	18

Conclusion.....	20
Works Cited.....	23
Appendix A.....	27
List of Names Associated with IEDs and IED Types	
Appendix B.....	29
2009 National Counterterrorism Center Statistical Data	
Appendix C.....	32
Spokane, Washington January 17, 2011 Backpack IED	
Appendix D.....	34
Confederate CWIED discovered near Columbus, Kentucky in March of 1862	
Appendix E.....	35
Confederate Saboteur John Waxwells Mechanical Time Delayed IED	
Appendix F.....	37
Confederate Courtena Coal Torpedo	
Appendix G.....	38
World War I Examples of IEDs	
Appendix H.....	39
World War II Examples of German IED Placement	
Appendix I.....	40
Example of VC/NVA VOIED	
Appendix J.....	41
Iraqi IED statistics June 2003 – May 2010	
Appendix K.....	44
Afghanistan IED Information	
Appendix L.....	46
JIEDDO FY Spending from FY2006 – FY2010	
Appendix M.....	47
Placement of a Roadside Explosively Formed Penetrator	

Preface

The opportunity to conduct the research for this project was highly educational and enjoyable for me. The increased awareness of this threat and some of its early origins has enhanced my professional knowledge, which will be invaluable to me in my federal civilian job as an IED Intelligence Analyst, as well as my U.S. Army Reserve career as an Explosive Ordnance Disposal Officer (EOD).

I would not have been able to complete this project had it not been for the support I received from so many people who enabled me to succeed. First, I would like to thank my wife and children for allowing me the time necessary to study and research when I could have been spending time with them. I would also like to thank my employer, the U.S. Marine Corps Intelligence Activity (MCIA), and specifically my Division Head Joseph Mobilia for allowing me to take the time away from the office to pursue the MMS.

I would also like to thank my MMS mentor Dr. Eric Shibuya for helping me through this project. Dr. Shibuya allowed me to follow my own course when tackling this project, but provided enough guidance to get me back on track each time I seemed to go off in the wrong direction. In addition to Dr. Shibuya I would be remiss if I did not mention Dr. Patrice Scanlon. Had it not been for the editorial, grammar and organizational help that she provided, this monograph would be a pile of unreadable words. Lastly, I would like to thank all of the brave men and woman of the military EOD career field and the Hazardous Device Technicians assigned to law enforcement bomb disposal squads for voluntarily putting their lives at risk to combat the deadly threat of IEDs.

Introduction

The dangers faced by the U.S. military and its coalition partners from improvised explosive devices (IEDs) will not go away at the completion of the wars in Afghanistan and Iraq. In truth, the threat of IEDs will most likely be greater in future conflicts. Data collected by the National Counter Terrorism Centers (NCTC) Worldwide Incident Tracking System and the University of Maryland Global Terrorism Database (GTD) shows IED use and device complexity throughout the world is increasing. This threat is here to stay and adversarial and transnational terrorist forces will seek to utilize IEDs against superior forces and to conduct acts of terrorism against civilian populations.

Lack of an Acceptable Definition

No universal definition of an IED existed prior to October 2003, when the U.S. Army established the U.S. Army IED Task Force. Even U.S. coalition partners used different definitions for an IED and its components. This lack of a commonly accepted set of terms reduced understandable reporting and intelligence exchanges. In February 2006, the Task Force reorganized itself into the Joint IED Defeat Organization (JIEDDO), and began to look for ways to reduce the disjointed reporting and develop a common language for the US military and its partners.

JIEDDO and the Defense Intelligence Agency (DIA) developed the *Weapons and Technical Intelligence (WTI) IED Lexicon* in June of 2007, in close coordination with the U.S. military, intelligence community (IC), and local, state, and federal law enforcement agencies to provide a commonly accepted set of definitions. The North Atlantic Treaty Organization (NATO) adopted the WTI IED Lexicon as the accepted definitions for describing IEDs and their

associated components in June 2009.ⁱ A common definition ensures the greatest degree of continuity when exchanging information on IEDs. According to a JIEDDO press release, “The Lexicon ensures that the United States and all NATO nations are talking the same language when it comes to IEDs, clearly outlining the common terms for IEDs and other improvised weapons enables better information fusion, from the tactical to strategic level.”ⁱⁱ

WTI IED Lexicon IED Definition

The WTI IED Lexicon defines an IED as a “device placed or fabricated in an improvised manner incorporating destructive, lethal, noxious, pyrotechnic, or incendiary chemicals and designed to destroy, incapacitate, harass, or distract. It may incorporate military stores (e.g. modified conventional military ordnance), but is normally devised from components (e.g. remote controls, timers, power sources).”ⁱⁱⁱ In the past, IEDs have gone by many different names (see Appendix A.). During the U.S. Civil War, names associated with IEDs and what ultimately became Naval Mines and Landmines, included Infernal Machine and Torpedo. IEDs run the gamut from technologically advanced custom built electronic firing devices to crude victim operated (VOIED) devices. Only the available resources, training, and ingenuity of the individual bomb-maker limit the design and functional capabilities of an IED.

Background on IEDs

Prior to OEF and OIF, most service members may only have been familiar with IED attacks because of large-scale events that resulted in widespread media reporting. Examples of these attacks include the 1983 suicide vehicle borne IED (SVBIED) attack against the U.S. Marine Corps Barracks in Beirut; the 1996 VBIED attack against the Khobar Towers Military Housing area in Saudi Arabia; and the 2000 water borne IED (WBIED) attacks against the

U.S.S. Cole. In total, these attacks resulted in 279 killed in action (KIA) and 471 wounded in action (WIA) U.S. military personnel.

All of the previous mentioned attacks occurred against identifiable military targets. However, IED attacks against civilian targets prior to OEF and OIF proved no less deadly. IED attacks targeting civilians included the 1988 Pan Am Airline bombing over Lockerbie, Scotland; the 1993 attack on the World Trade Center; the 1995 Oklahoma City Bombing; the 1996 Centennial Olympic Park Bombing in Atlanta, Georgia; and the 1998 U.S. Embassy bombings in the East African cities of Dar es Salaam, Tanzania and Nairobi, Kenya. In total, these attacks resulted in 502 killed and 5,918 wounded civilians. Other IED attacks included bombings conducted by Ted Kaczynski (The Unabomber), the Irish Republican Army (IRA) and attacks conducted by terrorists in the Middle East.

None of the previously mentioned attacks represents the beginnings of the IED threats faced by the U.S. military today. The use of IEDs against U.S. military service members can be traced back as early as the U.S. Civil War. This monograph will highlight past U.S. military operations in which service members encountered IEDs. It will not examine every single device type encountered or document every IED event since the U.S. Civil War. Rather, the intent of this monograph is to educate the reader on how this threat will continue to impact future U.S. military operations, highlight the possibility that IEDs developed and used within Afghanistan and Iraq could appear domestically within the United States of America and identify potential TTPs for combatting this threat in the future.

The use of IEDs as a weapon system for producing casualties and as a tactic for instilling fear and doubt did not develop from OEF and OIF.^{iv} Insurgents, terrorists, and conventional

adversaries utilized IEDs to level the playing field against the U.S. military long before those conflicts. Analysis of historic uses of IEDs against the U.S. military is beneficial in determining the threat of IEDs and its evolution on the battlefield.

A Tool for Leveling the Playing Field

All types of adversaries utilize IEDs as a method for leveling the playing field against a superior conventional military force. IEDs are a popular weapon because they are relatively cheap to produce, easy to make, have multiple mission roles, and are difficult to detect and trace.^v The ability of these devices to produce a large number of casualties and generate massive amounts of damage attracts widespread media reporting. Spectacular IED attacks requiring a relatively small investment can propel a group onto the world stage. This notoriety may assist in drawing other supporters or inciting similar types of attacks. The use of IEDs provides both a strategic and tactical level of influence normally unavailable to less equipped, manned and trained adversarial forces.

Impacts of IED Attacks

Strategic Impacts of IED Attacks

Analysis of IED events shows that IED attacks occur on two distinct levels, strategic and tactical. A concentrated use of IEDs over a sustained period then becomes an IED campaign.^{vi} Strategic level IED attacks are those events designed to receive widespread media reporting because of large-scale destruction to the intended target and high numbers of casualties. The intent of a strategic level IED attack is to influence and alter public perception because of an individual or a series of catastrophic events. An example is the 2004 Madrid bombing. It killed more than 250 people, but its real impact was that it led to a change in the Spanish government

and accelerated the withdrawal of Spanish forces from Iraq.^{vii} Lt. Gen. Thomas Metz, former director of JIEDDO stated, "That explosion occurred on a Thursday and affected the course of a government. An election took place on Sunday, and a new government was in place on Monday."^{viii}

Tactical Impacts of IED Attacks

The majority of IED incidents that occur against U.S. military service members are tactical level IED attacks. Tactical level IED attacks limit mobility within the battlespace, and harass, delay, or defend against the opposing forces. Service members subjected to the damaging effects of IEDs at both the strategic and tactical level, not only experience physical damage to equipment and personnel, but also the psychological impacts that damage and reduces effective military operations.

Psychological Impacts of IEDS

The use of IEDs as a weapon is attractive to insurgents and terrorists not only for its physical destructive power, but also for its psychological effects. The fear and uncertainty that service members experience after being subjected to numerous IED attacks causes them to second-guess themselves before advancing into the battlespace. The psychological effect that IEDs have upon the individual service member adds additional stress to those already strained by combat operations.^{ix} This stress can manifest itself in emotions of fear, anger, and dehumanization of the enemy. A sustained IED campaign can instill fear and doubt of the security environment among military service members reducing overall combat effectiveness.

Global IED Statistics

Of all of the tactics associated with insurgents and terrorists, the use of IEDs represents the second most commonly used tactic among these groups, with armed assault being number one.^x The NCTC *2009 Report on Terrorism* estimated that 10,999 acts of terrorism occurred in 83 different countries. Of these acts, there were 5,321 Armed Attacks / Assaults and 4,349 IED attacks that occurred in 2009 (see Appendix B).^{xi} IED attacks provide adversarial forces with a mechanism to conduct high profile attacks against iconic targets (e.g. U.S. Embassy or U.S.N Ship) that normally would be out of their reach due to personnel, training and equipment constraints.

According to the GTD, between 2001 and 2008 there were an estimated 5,378 IED related attacks throughout the world.^{xii} This number does not include IED attacks within Afghanistan and Iraq. The majority of these incidents took place between 2005 and 2007, roughly during the same period coalition forces within Iraq began to experience a major increase in the numbers of IEDs encountered.^{xiii} The highly publicized success of IED uses in Iraq influenced IED device design, tactics and use during this period throughout the world and is likely to continue to do so into the future. According to Lt. Gen. Thomas Metz "We are in an era of persistent conflict and anyone who thinks an IED is just a military problem overseas is being naïve. IEDs are the weapon of choice for terrorists for the next two to three decades".^{xiv} A separate GTD study reported an estimated 66,509 terrorist attacks with IEDs as the primary attack method occurred in 205 countries between 1970 and 2004, to include the United States of America (USA), highlighting the global nature of this threat and its value as both a strategic and tactical weapon.

IED Threats to the United States of America

According to data provided by the Bureau of Alcohol Tobacco Firearms and Explosives (BATFE) since 1978, approximately 46,000 IED and explosive bombing related events occurred within the USA. An average of 1,394 events occurs annually throughout the USA.^{xv} Almost all of these events are attributable to criminal activities and domestic acts of terrorism, such as the bombing of abortion clinics. The IED types encountered by police bomb squads are generally simple rudimentarily designed IEDs (e.g. pipe bombs).

If domestic terrorists, criminal organizations, or transnational terrorists began to mimic IED types and TTPs found within Afghanistan and Iraq, police bomb squads should align themselves with their military counterparts in order to develop CIED solutions for combatting this threat and to learn from the military's recent IED experiences. The use of high tech radio control initiated or sensor fired IEDs infrequently occurs within the USA. Because of this, police bomb squads are not universally equipped to deal with advanced threats. Due to limited funding in smaller agencies, some bomb squads do not even have CIED robots.

On January 17, 2011, police responding to a suspicious backpack discovered a roadside emplaced RCIED with a directional fragmentation charge along a parade route in Spokane, Washington. The IED consisted of a main explosive charge, fragmentation and a car alarm receiver for triggering the IED (see Appendix C.).^{xvi} This device is similar to IEDs used in Iraq and Afghanistan in the manner in which it was constructed and placed. This device shows that the possibility of IED types once used against the military outside of the USA can now become a domestic problem.

Use of IEDs in American Conflicts

U.S. Civil War

The necessity of the U.S. military to develop CIED TTPs existed as early as the U.S. Civil War and continues on to today with the wars in Afghanistan and Iraq. The use of IEDs and what ultimately became landmines during the U.S. Civil War is important to examine when putting today's IED problem into context. Their use during the war represents the first time the U.S. military encountered devices of this nature and demonstrates TTPs from the original uses of IEDs are similar to those encountered today. Throughout the war, the Confederates looked for ways to address the imbalance between themselves and the Union Army.^{xvii} The use of IEDs was an attempt to meet this challenge.

Confederate IED Designs

Many IED intelligence analysts and military weapons historians consider the IEDs designed and used by the Confederates as technologically advanced for their time. One of these devices was a command detonated, electrically fired IED discovered by Captain W. A. Schmitt and a company, of the Twenty Seventh Regiment of the Union Army, near Columbus, Kentucky in March of 1862.^{xviii} The IEDs consisted of a squat iron case with handles resembling a cooking pot. The pot contained four modified eight-pound artillery projectiles filled with grape shot fragmentation (see Appendix D.).^{xix} Union troops discovered over 100 of these devices buried in clusters around the defensive works of Columbus, Kentucky connected to a command wire (CWIED) and hand cranked electrical firing device.^{xx} Confederate soldiers could activate these CWIEDs from a control room in a nearby cave, once Union troops entered the IEDs killzone. Alexander Simplot, a correspondent from the Chicago Times present at the discovery in 1862

stated “The result may be imagined, whole regiments could thus be blown up and sent to eternity, without even a chance of escape” if confederates detonated the IEDs against unknowing Union troops.^{xxi}

Confederate IED Sabotage Attacks

On August 9, 1864, Confederate saboteur John Waxwell smuggled a mechanical time-delayed IED aboard a Union Army ammunition supply barge at port in City Point, Virginia.^{xxii} City Point served as the location of General Ulysses S. Grant’s headquarters and a Union supply depot. Conducting a conventional attack against a heavily defended Union base of operations required a large amount of troops and equipment, neither of which the Confederacy had in disposable amounts. However, a lone saboteur conducting an IED attack required a minimal amount of support and equipment. If successful, the attack would demonstrate the Confederacy’s ability to conduct high profile attacks in the Union’s rear areas. Maxwell's time delay initiated IED consisted of a wooden box marked "Candles", filled with 12 pounds of black powder and the time delayed detonating mechanism (see Appendix E).^{xxiii} When the device detonated, it killed 58 Union troops and 126 civilians near the barge and produced an estimated \$4 million in damages to Union supplies (see Appendix E).^{xxiv}

Similar to the City Point attack, Captain Thomas E. Courtena of the Confederate Army created an IED to attack Union steam powered ships and locomotives. The IED, later named the “Courtena Coal Torpedo,” was a piece of hollow cast iron, shaped like a lump of coal filled with black powder and a Powder Train Time Fuze (PTTF) firing mechanism (see Appendix F).^{xxv} The IED was smuggled into Union coal supplies, and then unknowingly shoveled into a Union steam ship’s firebox or a locomotive’s engine by Union sailors and steam locomotive engineers.

The cast iron casing of the IED heated and ignited the black powder PTF and main charge, which destroyed the boiler. Confederate saboteurs are suspected of destroying over 60 Union steam ships on the Mississippi River during the Civil War, many of which were destroyed by IEDs such as the “Coal Torpedo.” Thousands of lives were lost when these steamers exploded.^{xxvi}

Confederate IED Targeting Practices

Confederate IED saboteurs demonstrated indiscriminate targeting practices when conducting attacks. Major General George B. McClellan stated, “The rebels have been guilty of the most murderous and barbarous conduct in placing [IEDs] within abandoned works near wells and springs; near flagstaffs, magazines, telegraph offices, in carpet bags, barrels of flour, etc....”^{xxvii} Accurate figures of how many IED attacks actually occurred throughout the Civil War and the number of casualties they produced is unknown. Historian Mike Croll estimates that the total number of IEDs and landmines used during the Civil War was probably fewer than 20,000.^{xxviii} The newly developed IED types constructed by the Confederates were the forerunners of the IEDs of the future. All of the IED types encountered during the Civil War reemerged 76 years later on the battlefields of Europe during World War I.

World War I

World War I saw the improvement of IED types first encountered during the Civil War. Mechanical time delay, VOIED and electrically initiated IEDs were the most commonly encountered IEDs during the war (see Appendix G.). These IEDs primarily served as a means of slowing advancing troops and covering German withdrawals. Trench warfare created a physical environment that easily lent itself to the use of IEDs. The dug out trenches, mud filled fighting

positions, shell holes and restrictive terrain allowed for easy placement and camouflaging techniques. When combined with the use of IEDs, the ability of advancing allied troops to pursue retreating German units greatly diminished. The IEDs used were of no strategic importance, however tactically they proved highly effective at harassing, delaying and instilling fear within allied troops.^{xxix}

Various IED types such as VOIED and CWIED were used to protect sentry positions and give advanced warning of approaching allied troops, but their main use was to cover withdrawals after local trench raids or to assist as maneuver obstacles in operations.^{xxx} In response to U.S. and British trench raids, German soldiers began manufacturing explosive filled mannequins disguised as German soldiers (see Appendix G.). The Germans placed the mannequins in shell holes and connected a battery and firing device.^{xxxi} When an allied soldier moved the mannequins for inspection, their VOIED mechanism functioned and detonated the explosive charge.

The actual numbers of U.S. casualties that resulted from IED attacks during World War I are unknown. Because of the non-standard nature of IEDs and the improvised manner in which they are created, their reliability is not always guaranteed. Given the enormous amount of losses experienced on both sides, the casualties caused by IED attacks is most likely minor when compared to deaths from new technologies such as poison gas, machine guns, flamethrowers, tanks and the airplanes.

World War II

As the value of IEDs became apparent based on their successes in the First World War for covering retreats and harassing the allies, the Axis mass-produced VOIED and mechanical

time delay initiated IEDs. The Axis placed IEDs on likely routes, inside of vehicles, buildings, equipment, and innocuous objects to delay and harass allied forces (see Appendix H.). IEDs inflicted a small proportion of casualties during the Second World War. Within the U.S. military, IEDs were the cause of the lowest number of casualties of any specific weapon used on the battlefield.^{xxxii} IED use accounted for 0.2% of those killed and 0.5% of those wounded.^{xxxiii} IED use against the U.S. military and its allies occurred in both the European and Pacific theaters primarily as a defensive weapon system used to limit maneuver space on the battlefield.^{xxxiv}

The use of IEDs has so far been relatively minor, however this will change by the time the U.S. military becomes involved in the Vietnam War. None of the previous U.S. military experiences with IEDs will compare to the level of the IED threat they will experience at the hands of adversarial forces within Vietnam. The ingenuity of IED construction and the TTPs for their use will produce more IED casualties than the U.S. military experienced in any previous conflicts in which IED attacks occurred.

Vietnam

IED use was extensive during the Vietnam War. During the course of the Vietnam War, the U.S. military sustained 58,169 KIA and 304,704 WIA. Of the total number of KIA, approximately 6,398 (11%) resulted from IEDs and mines, and 51,799 (17%) were WIA.^{xxxv} What the Vietcong (VC) and the North Vietnamese Army (NVA) lacked in the way of firepower, they made up for in ingenuity with homemade weapons, guerilla tactics and IEDs. The VC and the NVA used IEDs in all phases of their operations from combat to sabotage primarily at the tactical level. The primary purpose of the VC and the NVA for using IEDs was to harass U.S. forces and generate casualties, fear and over cautiousness.^{xxxvi} The use of modified ordnance

items, primary and secondary IEDs, and the specific targeting of CIED personnel were all viable TTPs associated with IED use in Viet Nam. The VC and the NVA used IEDs to disrupt the mobility of US forces and they forced resources to be used for static guard duties and other clearance operations. ^{xxxvii}

Unlike previous U.S. military experiences where IED use centered on limiting maneuverability within the battlespace as a defensive measure, the VC and the NVA used IEDs primarily as a tool for conducting offensive actions at the tactical level. IEDs were a key component in pre-arranged killing zones and often an integral part of conducting ambushes. ^{xxxviii} The VC and NVA became very adaptive at IED uses based on identifiable U.S. military patterns and TTPs. The use of IEDs such as CWIED and VOIEDs dominated the VC and NVA IED arsenal (see Appendix I.) The VC and the NVA validated the IED as an offensive weapon.

Post-September 11, 2001 (Iraq and Afghanistan)

Iraq: “The Challenge Project”

The former Iraqi Intelligence Services (IIS) Special Operations and Antiterrorism branches led the initial IED campaign against the U.S. military and coalition forces in Iraq from 2003 until 2005. The “Challenge Project” was a plan developed by the IIS to engage the coalition through a state sponsored insurgency campaign plan focused heavily on the use of IEDs. ^{xxxix} This allowed a few thousand insurgents and foreign fighters, with professionally trained state sponsored professional leadership taken from small numbers of the IIS and seasoned military officers, specifically trained in the use and construction of IEDs to effectively target, and engage the coalition. ^{xl}

As the insurgency continued to grow beyond grass roots movements to foreign fighters crossing the border of Iraq to conduct attacks, the number of IEDs and the complexity of the devices grew exponentially. The IED threat grew beyond the initial intent of the “Challenge Project” and turned into sectarian violence between both Sunni and Shia with coalition troops being targeted with IEDs by both sides. The use of IEDs within Iraq became the largest producer of casualties for the U.S. and its coalition partners.

IED Casualty Data for Iraq

From 2005 – 2010, an estimated 1770 (40%) of U.S. troops were killed because of an IED attack with approximately 14,055 (44%) of U.S. troops wounded within Iraq.^{xli} The civilian population of Iraq also suffered greatly because of IED attacks. Because of collateral damage or by direct targeting due to sectarian violence, thousands of Iraqis died because of IED attacks. Iraqi civilian casualties during 2005-2010 are difficult to put an accurate number on, however newly released data from the Pentagon estimates that insurgents in Iraq killed more than 21,000 civilians and wounded another 68,000 people with IEDs.^{xlii} According to a study conducted by the Center for Strategic and International Studies, approximately 86,127 IED related incidents occurred in Iraq between June 2003 and May 2010 (see Appendix J).

Afghanistan

Afghanistan developed its IED problem at a slower rate than Iraq. U.S. forces encountered IEDs within Afghanistan from the very beginning of OEF, but their use and numbers did not dramatically increase until after the increase in U.S. troop levels and combat operations in 2007 (see Appendix K). The higher troop levels led to increased numbers of combat operations against the Taliban. The Taliban in turn responded with greater numbers of

IED attacks throughout Afghanistan. Since 2001 the Taliban have continued to get better at conducting IED attacks because of increased familiarity of IED device construction, continued IED training and sharing of IED information between themselves and foreign fighters. In 2010, IEDs wounded 3,366 U.S. military service members, nearly 60% of the total IED wounded since the war began in 2001.^{xliii} In nine years of war, 617 American troops were killed by IEDs with the majority of those deaths occurring in the past two years. The 268 troops killed by IEDs in 2010 account for more than 40% of all deaths caused by IEDs during the war.^{xliv}

Not the Same as Before

No prior wars or conflicts throughout the world ever witnessed such overwhelming use of IEDs. The British experiences in Northern Ireland and the Israeli experience in the Middle East are the closest examples to what the U.S. and its coalition partners experienced within Afghanistan and Iraq. During the conflict between the IRA and the British Government, the use of IEDs wreaked havoc on the British military and civilian populations. From the late 1970s until 1992 the IRA bombing campaign committed over 10,000 IED attacks throughout Northern Ireland and mainland Great Britain.^{xlv} It was the first national insurrectionist group to conduct a sustained IED campaign, with more than 50% of all British military killed during the conflict with the IRA resulting from an IED attack.^{xlvi}

In Afghanistan and Iraq, adversarial forces use IEDs for their offensive capabilities in order to achieve their strategic and tactical goals much in the same way that the IRA and Middle Eastern terrorist battling Israeli forces conducted IED attacks, but on a much larger scale. The unprecedented use of RCIEDs, VBIEDs, anti-armor IEDs (AAIED) and suicide bombers severely affected the U.S. and its coalition partners' ability to control the battlespace. Although

these IED device types and TTPs occur in other areas throughout the world, insurgents and terrorist within Afghanistan and Iraq perfected their use. It took IRA terrorists over 30 years to conduct over 10,000 IED attacks. Iraqi insurgents conducted over 10,000 IED attacks within the first 19 months of OIF.^{xlvii}

As the use of IEDs within Iraq and Afghanistan escalated out of control, the need to address this growing threat became apparent. JIEDDO officially became the DoD entity responsible for coordinating all DoD wide efforts to reduce or eliminate the effects of all forms of IEDs against U.S. and coalition forces, including policy, resourcing, materiel, technology, training, operations, information, intelligence, assessment, and research.

JIEDDO CIED Efforts

As the wars in Afghanistan and Iraq began, nobody within the DoD or the IC foresaw the oncoming threat of IEDs to the level in which it would become by late 2004-2005. Regardless of historic data that existed pertaining to IED use against the U.S. military in previous wars, the DoD as a whole was unprepared for the IED threat of the modern asymmetric battlefield. Although the use of IEDs against U.S. troops is nothing new, very few CIED initiatives existed in the early stages of the wars capable of addressing this escalating threat.

Prior to JIEDDO's establishment, individual services controlled their own CIED efforts for staffing, training and equipping their forces to deal with IEDs, and no efforts to actively target bomb maker networks existed. Through the efforts of the JIEDDO, material solutions such as the Mine Resistant Ambush Protected (MRAP) vehicle fleet and electronic countermeasure (ECM) systems designed to defeat electrically initiated and RCIEDs were rapidly developed and deployed. Also, collaborative efforts between the DoD and the U.S. IC to attack the network of

IED manufactures has contributed largely to the reduced numbers of successful IED attacks against the U.S. military.

JIEDDO CIED Funding and Training

Standardized CIED training and new joint doctrine has also developed at a rapid pace since 2006, in an attempt to stay ahead of efforts to utilize IEDs against the U.S. military. JIEDDO now provides a focal point for all of the DoD efforts addressing CIED initiatives. It now ensures coordination amongst the services, IC, law enforcement, academia and industry so that U.S. troops are aware of the IED threat on the next battlefield. During the years of 2004 to 2006, JIEDDO spent approximately \$6.1 billion on military CIED initiatives. Additionally from 2006 through 2010, the organization has spent or obligated funding for CIED initiatives in excess of \$17 billion dollars, with an additional \$3.47 billion budgeted for fiscal year 2011 (see Appendix L.). These CIED expenses, in equivalent dollars, are comparable to the costs of the Manhattan Project.

Future IED Threat

Current operations within Afghanistan and Iraq demonstrated the effectiveness of IEDs for attacking the U.S. military and its coalition partners. News of successful IED attacks against forward deployed U.S. military units will spread throughout the world community and encourage other insurgent and terrorist organizations to conduct similar attacks. The use of IEDs will continue in future conflicts that the U.S. military participates in, and the overall lethality, complexity, and numbers of these attacks will increase.

Terrorist or insurgency groups that obtain state sponsorship have the ability to increase their effectiveness in preparing and conducting IED attacks. State versus non-state actors can

demonstrate noticeable differences within their capabilities and complexity of attacks. Less mature organizations that do not have increased resources such as finances, trainers, materials or safe haven will not be able to conduct attacks on the same level as state sponsored or more mature organizations.

When Iraqi Shia insurgents began to use Explosively Formed Penetrators (EFP) suspected of being supplied by the Iranian Revolutionary Guard Corps (IRGC), the number of successful IED attacks resulting in a mobility kill of a vehicle, or death and injury of a service member began to dramatically increase.^{xlviii} The number of casualties compared to the actual number of attacks associated with these IEDs was disproportionate. EFPs produced more casualties per IED attack than any other type of roadside emplaced IED within Iraq (see Appendix M.).^{xlix} The state sponsorship provided by the IRGC to the Iraqi Shia in both IED construction materials and training, showed a definable difference in the sophistication and overall lethality of their IEDs when compared to the non-state sponsored Iraqi Sunni insurgents.

When states collapse such as the former Soviet Union, or Iraq, the fracturing of governmental organizations with access to finances, weapons, training, and other resources allows these resources to be delivered through overt and covert means to insurgents and terrorist organizations. As insurgent and terrorist groups obtain these assets, the potential for greater attacks utilizing IEDs against the U.S. military and other coalition forces exists.

TTPs for Combatting the IED Threat

One of the most important TTPs to countering the IED threat that needs improvement is the ability to attack the IED network. Law enforcement, military, the IC and coalition partners need to learn better methods to attack the network responsible for emplacing the device and

preventing the IED attack from ever happening. An IED is the product of a group effort that includes at the very least a financier, trainer, bomb maker, surveillance team, emplacement team, and finally the attacker that triggers the device. By removing individual nodes of this network, the ability to get the IED to the battlefield is disrupted. This allows for the execution of offensive actions rather than defensive measures to mitigate the IED's effects. Increased collaboration between military, law enforcement, coalition partners, and the IC are essential in order to identify the IED network within their particular area of responsibility. Through collaboration, direct targeting of specific elements of the IED network becomes achievable.

The JIEDDO identifies the three tenets of CIED as "Train the Force, Defeat the Device, and Attack the Network". All three tenets are important when confronting the threat of IEDs, however attacking the network is the only tenet that is offensive in nature. Attacking the IED networks physically removes their ability to conduct IED attacks. Throughout the IED network, an identifiable series of events takes place leading up to an IED attack (e.g. procurement of bomb making materials, recruitment of network members, training of teams, and surveillance of the target). The development of TTPs and technologies capable of better identifying these signature events should be considered a top priority when developing CIED TTPs. In 2007, a Pentagon spokesperson told the Washington Post, "If you don't go after the network, you're never going to stop these guys; they'll just keep killing people".¹

Conclusion

Insurgents and terrorists within Afghanistan and Iraq have demonstrated to the world community, just how highly effective IEDs can be.ⁱⁱ As insurgents and terrorists continue to conduct successful IED operations, their notoriety will continue to grow. This will encourage

others to mimic these types of attacks. The use of IEDs enables less equipped forces to level the playing field when conducting operations against larger, military forces. Sharing training techniques between groups, creating standardized manuals, dispatching mobile training teams, establishing training camps, and utilizing the internet greatly increases the exchange of information between insurgents and terrorist groups. These efforts will continue to promote effective and deadly IEDs and increase the chances for proliferation from one group and theater to another. Proliferation of IEDs and TTPs will hamper future U.S. military combat operations and increase the threat of these devices appearing domestically within the USA.

While the explosives and IED types may have changed due to advancements in technology, many of the same employment principles, means of concealment and initiation methods, to accomplish the same strategic and tactical level goals such as delay, harass, and demoralize an enemy are the same today as they were 150 years ago. This monograph shows that IEDs are not a new phenomenon; however, IEDs are now a weapon of choice for insurgents and terrorists on a global scale.ⁱⁱⁱ The use of IEDs continues to escalate globally in both lethality and strategic impact, beyond their traditional uses as a tactical defensive weapon system. The use of media platforms like the internet and television now enables IEDs to be used as a strategic weapon of influence capable of creating great political impact against the established governments that are subjected to IED attacks against their militaries and civilian population.

ⁱ Joint Improvised Explosive Device Defeat Organization, "Lexicon Brings Big Improvement in Using Counter-IED Information", Press Release Number 09-06-09-01. Posted on June 9 2009, <https://www.jieddo.dod.mil/article.aspx?ID=513> (accessed January 05, 2011).

ⁱⁱ Ibid

ⁱⁱⁱ Joint Improvised Explosive Device Defeat Organization, *Weapons Technical Intelligence Improvised Explosive Device Lexicon*, (Washington D.C: Defense Intelligence Agency, June 06,), 1.

^{iv} Devlin, Philip. "American Revolutionary Patriots Invented IEDs." *theamericanmercury.org*, January 18, 2011. <http://theamericanmercury.org/2011/01/american-revolutionary-patriots-invented-ieds/> (accessed January 18, 2011)

^v CSM James J. Gallagher USA (RET), *Low Intensity Conflict: A Guide for Tactics, Techniques, and Procedures* (Pennsylvania: Stackpole Books, 1992), 82.

^{vii} Corderre, Michael. "Fighting Back Against IEDs" *policemag.com*, September 17, 2009. <http://www.policemag.com/Channel/SWAT/Articles/2009/09/Fighting-Back-Against-IEDs.aspx> (accessed February 28, 2011).

^{viii} Ibid

^{ix} Ian Jones, *Malice and Afterthought*, (Pennsylvania: Stackpole Books, 2004). 14.

^{*} National Counterterrorism Center. *2009 Report on Terrorism* (Washington, DC: April 30, 2010), 22.

^{xi} Ibid

^{xii} Global Terrorism Database, START, <http://www.start.umd.edu/start/research/projects/project.asp?id=59> (accessed January 05, 2011).

^{xiii} Vanden Brook, Tom. "IEDs Go Beyond Iraq and Afghanistan." *usatoday.com*, May, 13; 2008. http://www.usatoday.com/news/military/2008-04-03-IED_N.htm (accessed January 18, 2011).

^{xiv} Corderre, Michael. "Fighting Back Against IEDs" *policemag.com*, September 17, 2009. <http://www.policemag.com/Channel/SWAT/Articles/2009/09/Fighting-Back-Against-IEDs.aspx> (accessed February 28, 2011).

^{xv} Bureau of Alcohol Tobacco Firearms and Explosives, "ATF FACT SHEET", Press Release. Posted on March 2010, <http://www.atf.gov/publications/factsheets/factsheet-improvised-explosives-devices.html> (accessed March 02, 2011).

^{xvi} Initial FBI Field Report detailing the specifics of the IED recovered on the January 17, 2011 in Spokane Washington..

^{xvii} Mike Croll, *The History of Landmines*, (Great Britain: Pen and Sword Books Ltd), 11.

^{xviii} Alexander Simplot, "Torpedoes at Columbus," *Harpers Weekly*, March 29, 1862.

^{xix} Mike Croll, *The History of Landmines*, (Great Britain: Pen and Sword Books Ltd), 11.
Although Mike Croll identifies this early electrical command wire fired devices as a landmine, based on the JIEDDO WTI IED Lexicon definition of what an IED is, the device encountered within 1862 is classified as an IED:

^{xx} Alexander Simplot, "Torpedoes at Columbus," *Harpers Weekly*, March 29, 1862.

^{xxi} Ibid

^{xxii} Civil War Torpedoes Examination of the Civil War's Infernal Machines as used by Confederate States Navy Submarine Battery Service, Confederate States Army Torpedo Bureau, Confederate States Secret Service, United States Navy, http://www.infernal-machines.com/_sgg/m1m3_1.htm (accessed January 11, 2011).

^{xxiii} Ibid

^{xxiv} Maxwell, John. Letter to Captain Z. McDaniel, 1864, in *The War of the Rebellion: A Compilation of the Official Records of the Union and Confederate Armies Series 1, Vol. 42, Part I*, ed. Robert N. Scott. (Washington, DC: Government Printing Office, 1893), 954.

^{xxv} Civil War Torpedoes Examination of the Civil War's Infernal Machines as used by Confederate States Navy Submarine Battery Service, Confederate States Army Torpedo Bureau, Confederate States Secret Service, United States Navy, http://www.infernal-machines.com/sgg/mlm3_1.htm (accessed January 11, 2011).

^{xxvi} Civil War St. Louis: The Boat Burners, <http://www.civilwarstlouis.com/boatburners/index.htm> (accessed January 12, 2011).

^{xxvii} Mike Croll, *The History of Landmines*, (Great Britain: Pen and Sword Books Ltd), 17.

^{xxviii} Mike Croll, *The History of Landmines*, (Great Britain: Pen and Sword Books Ltd), 20.

^{xxix} Ian Jones, *Malice and Afterthought*, (Pennsylvania: Stackpole Books, 2004). 23

^{xxx} Ian Jones, *Malice and Afterthought*, (Pennsylvania: Stackpole Books, 2004). 24

^{xxxi} Ibid

^{xxxii} Gordon Rottman, *World War II Axis Booby Traps and Sabotage Tactics*, (Oxford: Osprey Publishing, 2009). 62.

^{xxxiii} Ibid

^{xxxiv} Ian Jones, *Malice and Afterthought*, (Pennsylvania: Stackpole Books, 2004). 115

^{xxxv} Ian Jones, *Malice and Afterthought*, (Pennsylvania: Stackpole Books, 2004). 241.

^{xxxvi} Headquarters United States Military Assistance Command Vietnam, *VC-NVA Employment of Mines and Booby Traps*, MACJ28 (San Francisco: Office of the Assistant Chief of Staff, Intelligence, June 1, 1967). 6.

^{xxxvii} Ian Jones, *Malice and Afterthought*, (Pennsylvania: Stackpole Books, 2004). 240.

^{xxxviii} Ibid

^{xxxix} Jehl, Douglas. "The Conflict in Iraq: Inspector's Report Says Hussein Expected Guerrilla War" *nytimes.com*, October 8, 2004.
<http://query.nytimes.com/gst/fullpage.html?res=9406E6DF153BF93BA35753C1A9629C8B63&ref=douglasiehl>
(accessed January 23, 2011).

^{xl} Ibid

^{xli} Vanden Brook, Tom. "TEDs Kill 21K Iraqi Civilians from 2005-2010." *Armytimes.com*, January 12, 2011.
<http://www.armytimes.com/news/2011/01/gannett-iraq-ieds-kill-21k-iraqi-civilians-from-2005-2010-011211/>
(accessed January 14, 2011).

^{xlii} Ibid

^{xliii} Vanden Brook, Tom. "Afghan insurgents match surge with more IEDs." *usatoday.com*, January 01, 2011.
http://www.usatoday.com/news/military/2011-01-10-ieds10_ST_N.htm (accessed January 23, 2011).

^{xliv} Ibid

^{xlv} A.R. Oppenheimer, *IRA The Bombs and The Bullets: A history of Deadly Ingenuity*, (Dublin: Irish Academic Press, 2009). 9.

^{xlvi} Ibid.

^{xlvii} Briefing on Iraqi IED Statistics conducted by the Center for Strategic and International Studies in July 2010, slide number 3.

^{xlviii} Gordon, Michael. "Deadliest Bomb in Iraq Is Made by Iran, U.S. Says" *newyorktimes.com*, February 10, 2007. <http://www.nytimes.com/2007/02/10/world/middleeast/10weapons.html> (accessed March 13, 2011).

^{xlix} Ibid

ⁱ Atkinson, Rick. "Left of Boom: The Struggle to Defeat Roadside Bombs Part 4" *washingtonpost.com*, October 3, 2007. <http://www.washingtonpost.com/wp-dyn/content/article/2007/10/02/AR2007100202366.html> (accessed March 2, 2011).

ⁱⁱ Duss, Matthew. "The Other Sons of Iraq: How the lessons of al-Qaeda learned in Iraq are informing the next generation of fighters." *Prospect.org*, June 22, 2009. http://www.prospect.org/cs/articles?article=the_other_sons_of_iraq (accessed January 18, 2011).

ⁱⁱⁱ Alexieff, Mike. "Official: IEDs a Global Threat" *kentuckynewera.com*, November 04, 2010. http://www.kentuckynewera.com/web/news/article_2aebb2d2-e836-11df-85b7-001cc4c03286.html (accessed January 23, 2011).

Works Cited

- Army, United States. *Viet Cong Boobytraps, Mines and Mine Warfare Techniques*. New York: University Press of the Pacific, 2004.
- Atkinson, Rick. "Left of Boom: The Struggle to Defeat Roadside Bombs Part 4." *Washington Post*, October 3, 2007. <http://www.washingtonpost.com/wp-dyn/content/article/2007/10/02/AR2007100202366.html> (accessed March 2, 2011).
- "BATFE Fact Sheets." BATFE. , <http://www.atf.gov/publications/factsheets/factsheet-improvised-explosives-devices.html> (accessed March 2, 2011).
- Corderre, Michael. "Fighting Back Against IEDs." *Police*, September 17, 2009. <http://www.policemag.com/Channel/SWAT/Articles/2009/09/Fighting-Back-Against-IEDs.aspx> (accessed February 28, 2011).
- Council, National Research. *Countering the Threat of Improvised Explosive Devices: Basic Research Opportunities, Abbreviated Version*. Bklt ed. Washington, D.C.: National Academies Press, 2007.
- Croll, Mike. *History of Landmines*. Barnsley: Pen and Sword, 1998.
- Defense, Department of. *Boobytraps Fm5-31*. Washington D.C.: Pentagon Publishing, 2004.
- Devlin, Philip. "American Revolutionary Patriots Invented IEDs." *The American Mercury*, January 11, 2011. <http://theamericanmercury.org/2011/01/american-revolutionary-patriots-invented-ieds/> (accessed January 18, 2011).
- Duss, Matthew. "The Other Sons of Iraq: How the lessons of al-Qaeda learned in Iraq are informing the next generation of fighters." *Prospect*, June 22, 2009. http://www.prospect.org/cs/articles?article=the_other_sons_of_iraq (accessed January 18, 2011).
- Fighting in the streets: a manual of urban guerilla warfare*. Fort Lee, NJ: Barricade Books ;,

1991.

Gallagher, James J.. *Low-intensity conflict: a guide for tactics, techniques, and procedures*.

Harrisburg, PA: Stackpole Books, 1992.

Gallimore, Andrew, and Lydia Monin. *The Devil's Gardens: A History of Landmines*. London: Pimlico, 2002.

Gander, Terry. *Guerrilla Warfare Weapons*. New York: Sterling Publishing Co, 1990.

Gordon, Michael. "Deadliest Bomb in Iraq Is Made by Iran, U.S. Says." *New York Times*, February 10, 2007.

<http://www.nytimes.com/2007/02/10/world/middleeast/10weapons.html> (accessed March 13, 2011).

Hogben, Arthur S.. *Designed to Kill*. Cambridge: Patrick Stephens Ltd, 1987.

"Infernal Machines - Torpedoes - Special Operations." Infernal Machines. http://www.infernal-machines.com/_sgg/m1m3_1.htm (accessed March 13, 2011).

Jehl, Douglas. "The Conflict in Iraq: Inspector's Report Says Hussein Expected Guerrilla War." *New York Times*, October 8, 2004.

<http://query.nytimes.com/gst/fullpage.html?res=9406E6DF153BF93BA35753C1A9629C8B63&ref=douglasjehl> (accessed January 23, 2011).

Marighella, Carlos. *Mini-manual of the urban guerrilla*. Montreal, QC: Abraham Guillen Press, 2002.

Mbe, and Ian Jones. *Malice Aforethought: The History of Booby Traps from WWI to Vietnam*. London: Greenhill Books, 2006.

Maxwell, John. Letter to Captain Z. McDaniel, 1864. In *The War of the Rebellion: A Compilation of the Official Records of the Union and Confederate Armies Series 1, Vol.*

42, Part I, edited by Robert N. Scott. Washington, DC: Government Printing Office, 1893.

Oppenheimer, A. R.. *IRA: The Bombs and the Bullets: a History of Deadly Ingenuity*. Dublin: Irish Academic Press, 2008.

Practical Bomb Scene Investigation (Practical Aspects of Criminal and Forensic Investigations). Boca Raton: CRC, 2006.

Rottman, Gordon. *World War II Axis Booby Traps and Sabotage Tactics (Elite)*. Oxford: Osprey Publishing, 2009.

Rule, G. E.. "Civil War St. Louis: The Boatburners." Civil War St. Louis.

<http://www.civilwarstlouis.com/boatburners/index.htm> (accessed March 13, 2011).

Simplot, Alexander. "Torpedoes at Columbus." *Harpers Weekly: A Journal of Civilization*, March 29, 1862. Vol. 6 No. 274.

"START DATABASE." University of Maryland Global Terrorism Database.

www.start.umd.edu/start/research/projects/project.asp?id=59 (accessed January 5, 2011).

Smith, Steve. *3--2--1 Bomb Gone: The Fight Against Terrorist Bombers in Ulster*. Seattle: The History Press, 2006.

Vandenbrook, Tom. "IEDs Go Beyond Iraq and Afghanistan." *USA Today*, May 13, 2008.

http://www.usatoday.com/news/military/2008-04-03-IED_N.htm (accessed January 18, 2011).

Vandenbrook, Tom. "Afghan insurgents match surge with more IEDs." *USA Today*, January 1,

2011. http://www.usatoday.com/news/military/2011-01-10-ieds10_ST_N.htm (accessed January 23, 2011).

Vandenbrook, Tom. "IEDs Kill 21K Iraqi Civilians from 2005-2010." *Army Times*, January 12, 2011. <http://www.armytimes.com/news/2011/01/gannett-iraq-ieds-kill-21k-iraqi-civilians-from-2005-2010-011211/> (accessed January 14, 2011).

Viet cong boobytraps, mines and mine warfare techniques . Honolulu: University Press of the Pacific/, 20041967.

Webster, Donovan. *Aftermath: The Remnants of War*. 1 ed. New York: Pantheon, 1996.

Chicago formatting by BibMe.org.

Appendix A.

Names Associated with IEDs

1. **Infernal Machine:** The term infernal machine originated in the 16th century in reference to unorthodox weapons, usually of an explosive or incendiary nature (hence "infernal"). In later centuries, the term was applied to a variety of similar weapons.
2. **Booby Trap:** Is an explosive or non-explosive device or other material, deliberately placed as an explosive or non-explosive device or other material, deliberately placed to cause casualties when an apparently harmless object is disturbed, a normally safe act is performed, or an assumed safe place is occupied.
3. **Torpedo:** During the US Civil War, the term "torpedo" was used to refer to various types of bombs and booby traps. Confederate General Gabriel J. Rains deployed "sub-terra shells" or "land torpedoes", artillery shells with pressure fuses buried in the road by retreating Confederate forces to delay their pursuers. Confederate secret agent John Maxwell used a clockwork mechanism to detonate a large "horological torpedo" (time bomb) on August 9, 1864.

IED Types

1. **Anti-Armor IED (AAIED):** IED incidents intended to damage or destroy armored vehicles and or kill or wound individuals inside armored vehicles. IEDs of this type include explosively formed penetrators (EFP), shaped charges, platter charges, and in some cases directionally focused fragmentation charges (DFFC).
2. **Command Switch:** A type of switch that is activated by the attacker in which the attacker chooses the moment of initiation.
3. **Command Wire IED (CWIED)** An IED initiated with a wire and power source, and may include a switch.
4. **Influence Fired:** A switch that incorporates a sensory input such as heat, movement, vibration, acoustic, magnetic, or light that causes the switch to function and initiate the device.
5. **Person Borne IED (PBIED):** IED worn by a person, such as a vest, belt, backpack, etc. in which the person houses the whole IED or principle IED components and or serves as the delivery or concealment means for explosives with an initiating device. Most commonly associated with suicide bombers, but not always.

6. **Radio Controlled IED (RCIED):** An IED initiated electronically in a wireless method consisting of a transmitter (i.e. personal mobile radio (PMR), cell phone, cordless phone, pager, etc...).
7. **Secondary Device:** An additional device emplaced in the target area to attack individuals or vehicles after the initial and secondary events.
8. **Time Switch:** A type of switch that functions after a set time. Used widely against infrastructure targets. Time switches can be electronic, mechanical, chemical, pyrotechnic (PTTF) or corrosive.
9. **Vehicle Borne IED (VBIED):** IED delivered by any ground based vehicle and or serves as the concealment means for explosives with an initiating device.
10. **Victim Operated IED (VOIED)** A type of switch that is activated by the actions of an unsuspecting individual, these devices rely on the target for the device carrying out some form of action that will cause the device to function.
11. **Water Borne IED (WBIED):** IED delivered by floating, drifting, anchored, or propelled on or below the water and or serves as the concealment means for explosives with an initiating device.

Source: Joint Improvised Explosive Device Defeat Organization, *Weapons Technical Intelligence Improvised Explosive Device Lexicon*, (Washington D.C: Defense Intelligence Agency, June 06,)

Appendix B.

2009 National Counter Terrorism Statistical Data

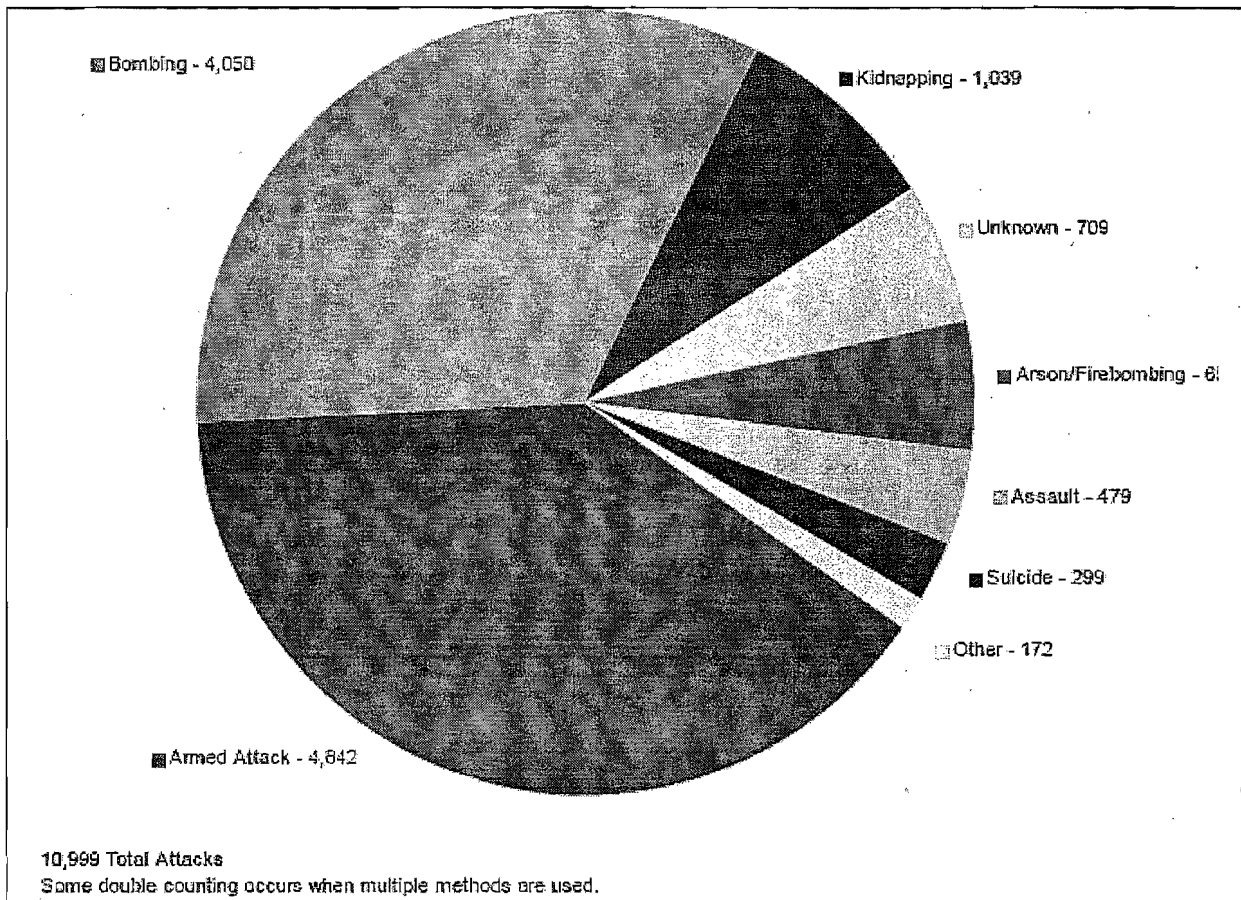


Figure 1. 2009 Primary Methods used In Attacks

Source: National Counterterrorism Center. *2009 Report on Terrorism* (Washington, DC: April 30, 2010)

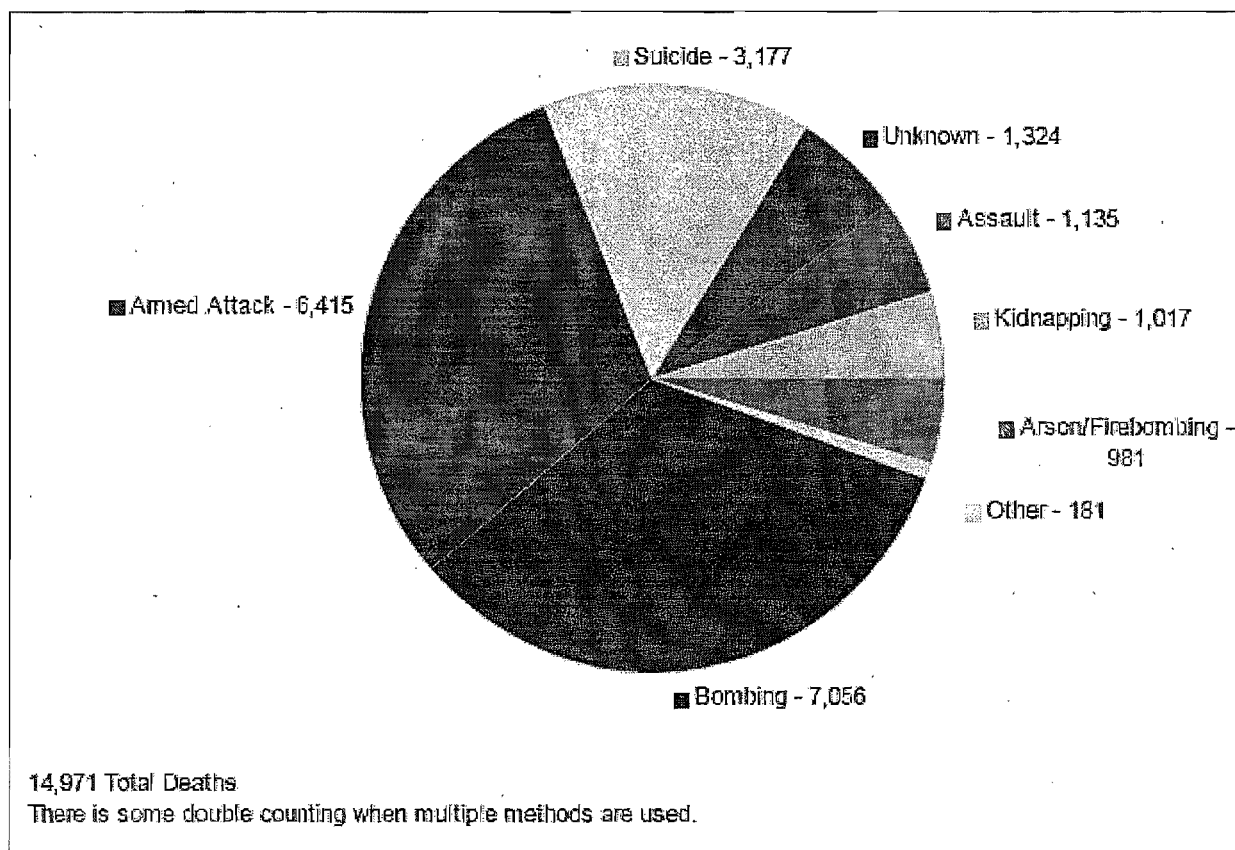


Figure 2. 2009 Deaths by Method of Attacks

Source: National Counterterrorism Center. *2009 Report on Terrorism* (Washington, DC: April 30, 2010)

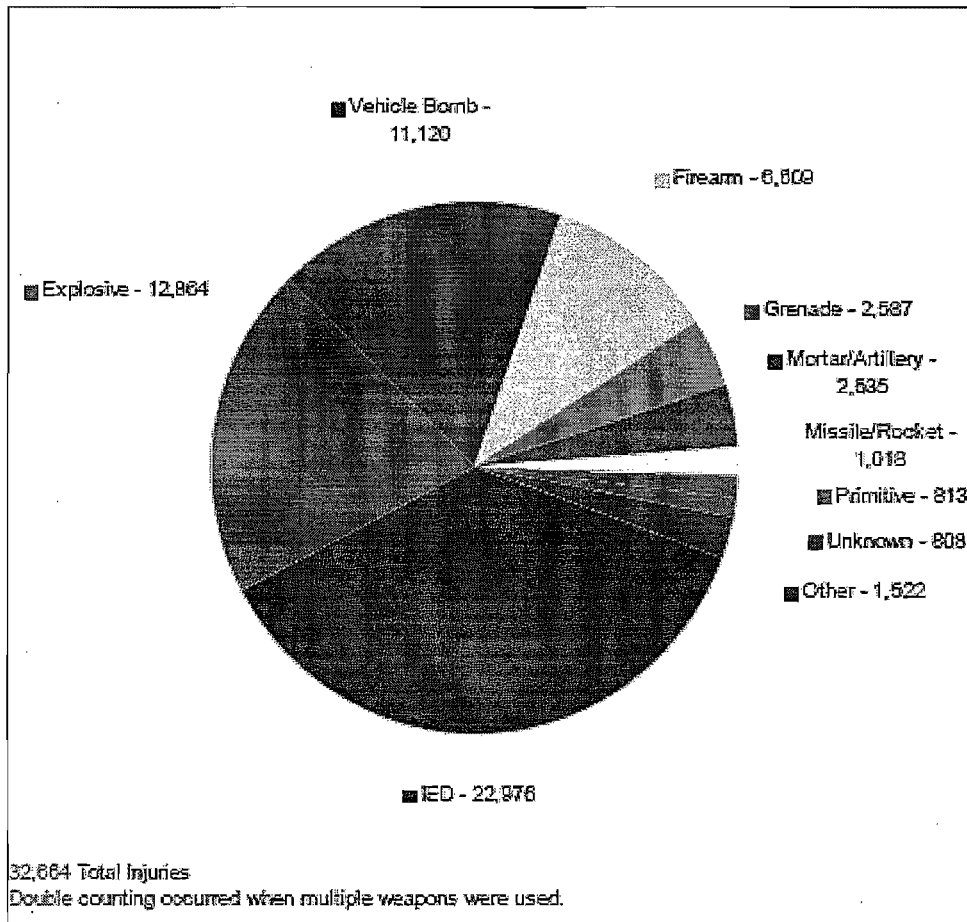


Figure 3. 2009 Injuries by Weapons used in Attacks

Source: National Counterterrorism Center. *2009 Report on Terrorism* (Washington, DC: April 30, 2010)

Appendix C.

Spokane, Washington

January 17, 2011 Backpack IED



Figure 4. Backpack Containing Explosive Device

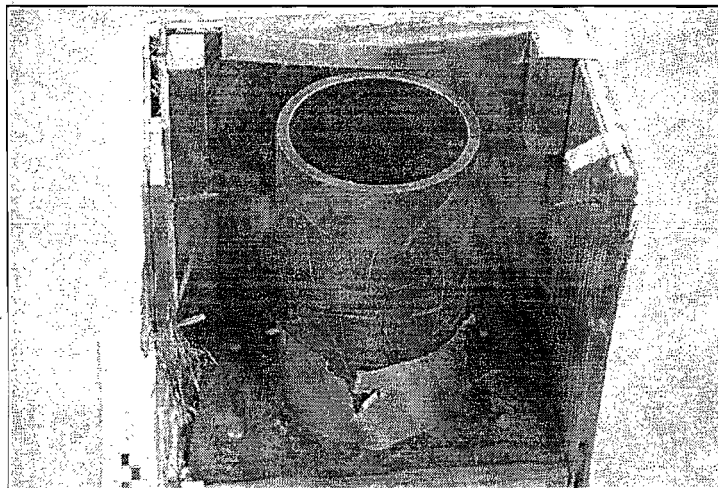


Figure 5. Steel Pipe in Main Charge Assembly

Source: <http://info.publicintelligence.net/FBI-SpokaneIED.pdf>



Figure 6. Lead Fishing Weights Coated with Rat Poison

Source: <http://info.publicintelligence.net/FBI-SpokaneIED.pdf>

Appendix D.

Confederate CWIED Discovered Near Columbus, Kentucky in March of 1862

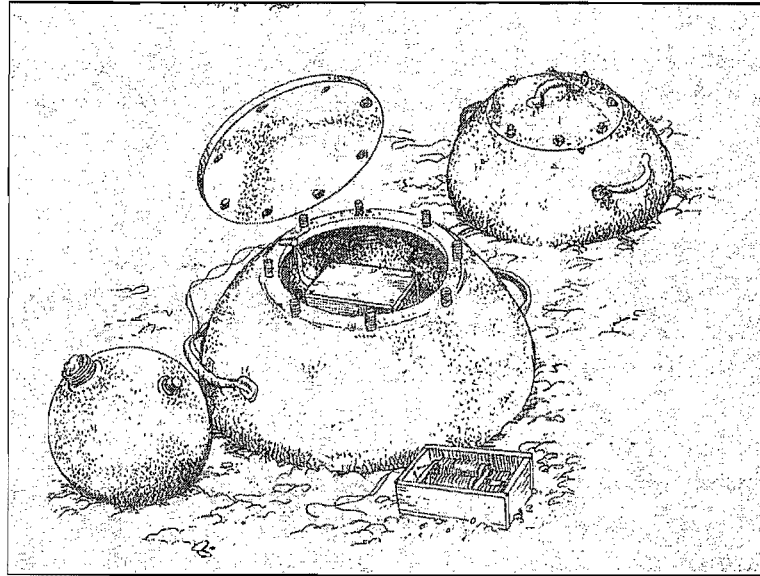


Figure 7. Steel Pot Containing Four Modified 8lb Artillery Projectiles and CWIED Device

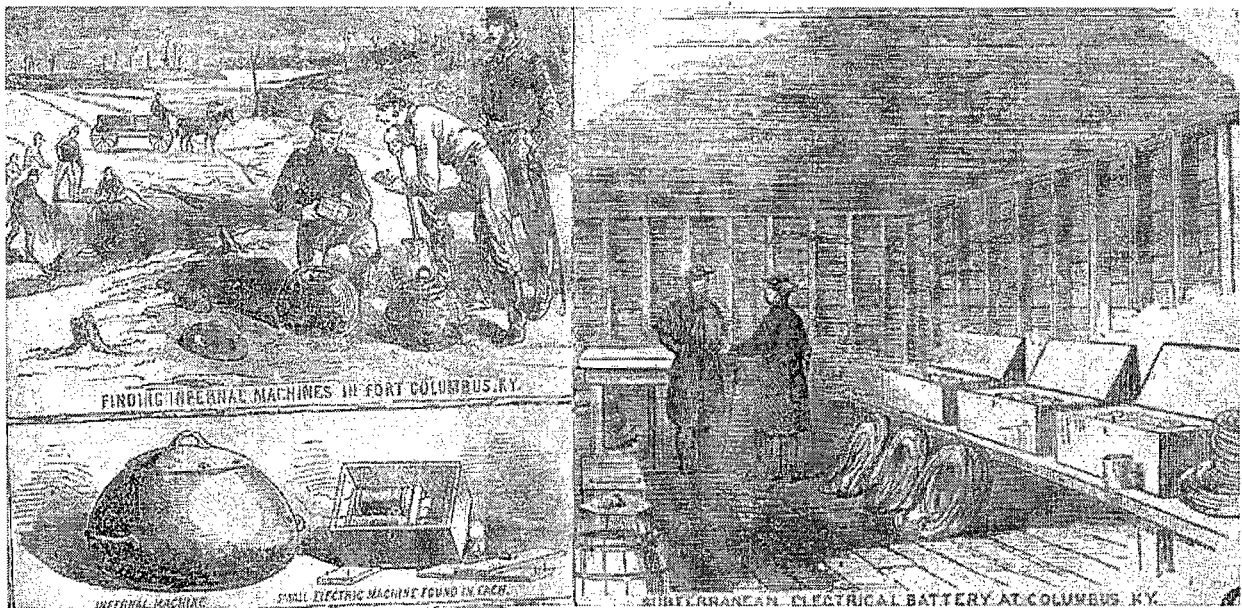


Figure 8. Discovery of Infernal Machines and Control Room at Fort Columbus KY 1862

Source: Mike Croll, *The History of Landmines*, (Great Britain: Pen and Sword Books Ltd)

Appendix E.

Confederate Saboteur John Waxwells Mechanical Time Delayed IED

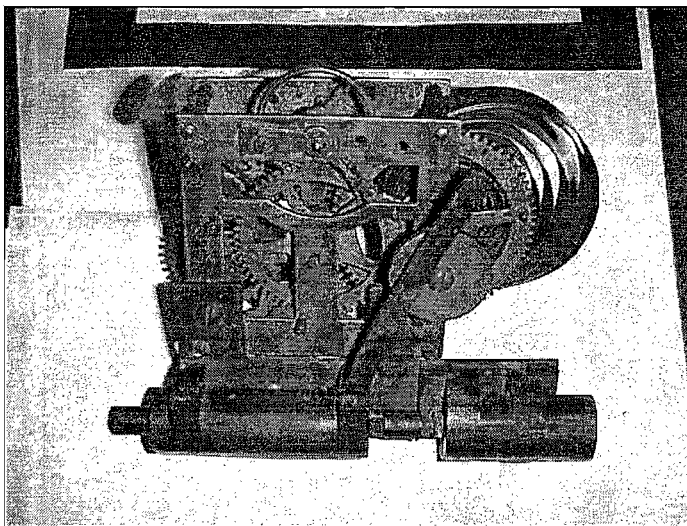


Figure 9. Horological Clockwork Mechanism for John Maxwells Time Delay IED

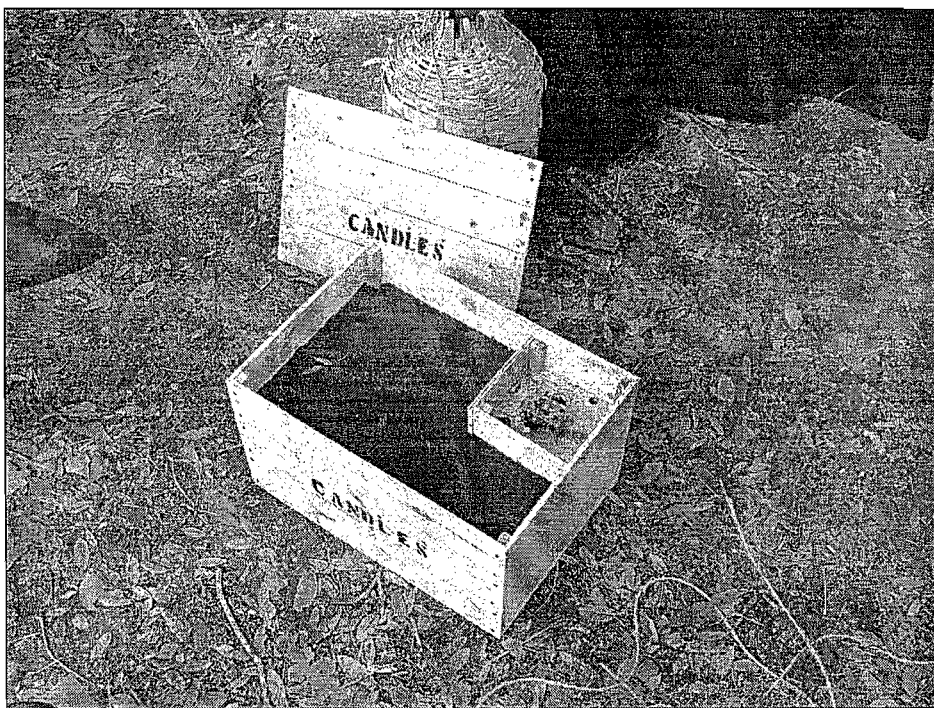


Figure 10. John Maxwells Disguised Time Delay IED

Source: http://www.infernal-machines.com/sgg/mlm3_1.htm

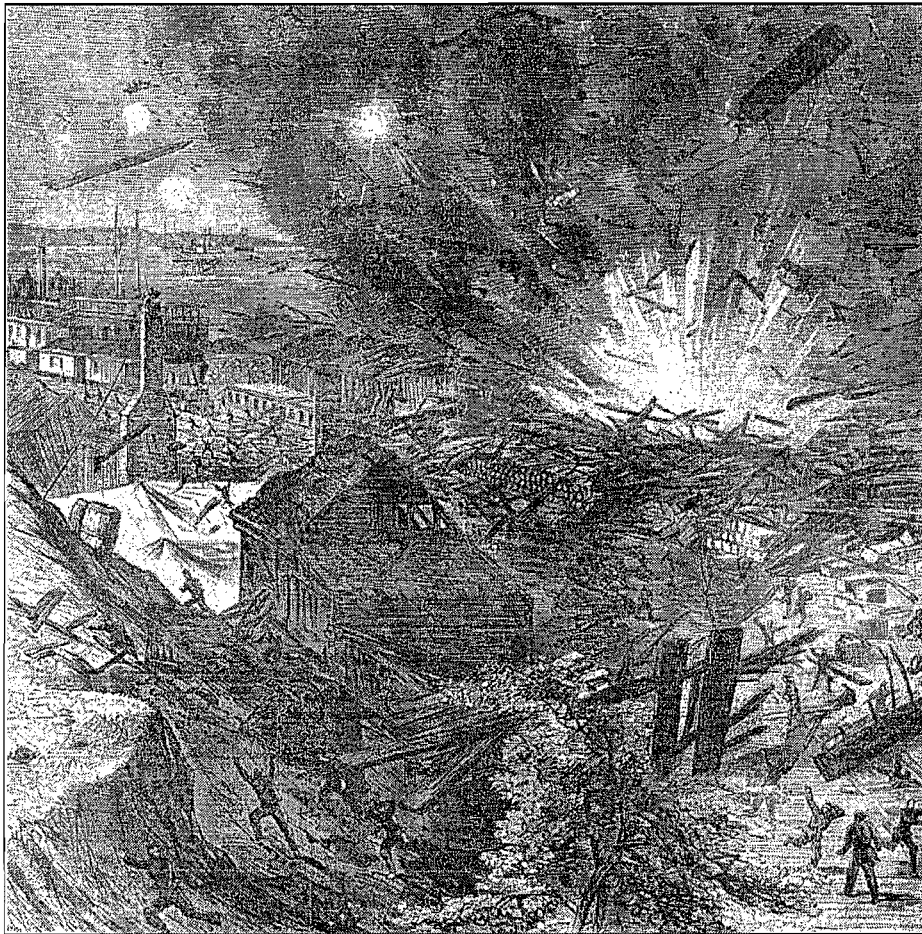


Figure 11. Destruction of City Point Wharf, August 9, 1864

Source: Harpers Weekly: A Journal of Civilization, VOL VIII., No. 400, August 27, 1864 (New York)

<http://www.sonofthesouth.net/leefoundation/civil-war/1864/explosion-city-point.htm>

Appendix F.

Confederate Courtena Coal Torpedo

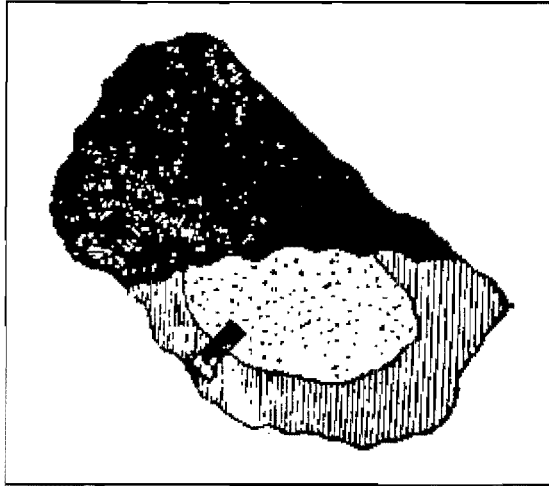


Figure 12. Confederate Courtena Coal Torpedo Diagram

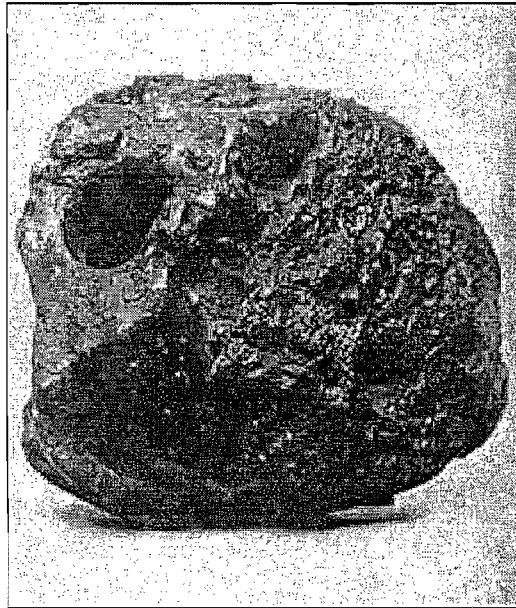


Figure 13. Recovered Confederate Courtena Coal Torpedo

Source Figure 12: <http://192.220.96.192/coal.htm>

Source Figure 13: <http://www.globalarchitectsguide.com/library/Coal-torpedo.php>

Appendix G.

World War I Examples of IEDs

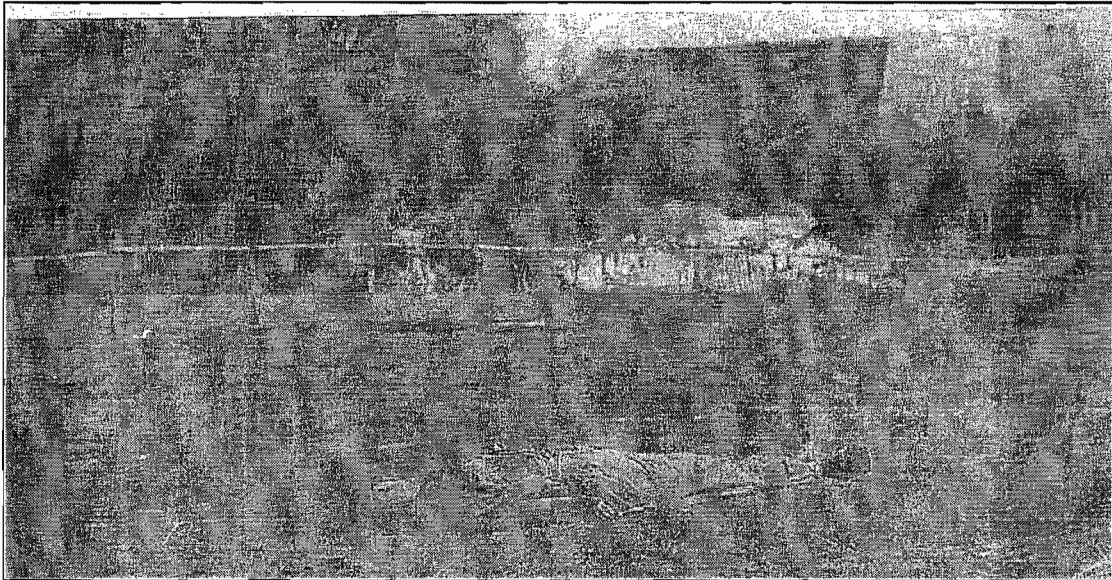


Figure 14. German Mannequin IED World War I

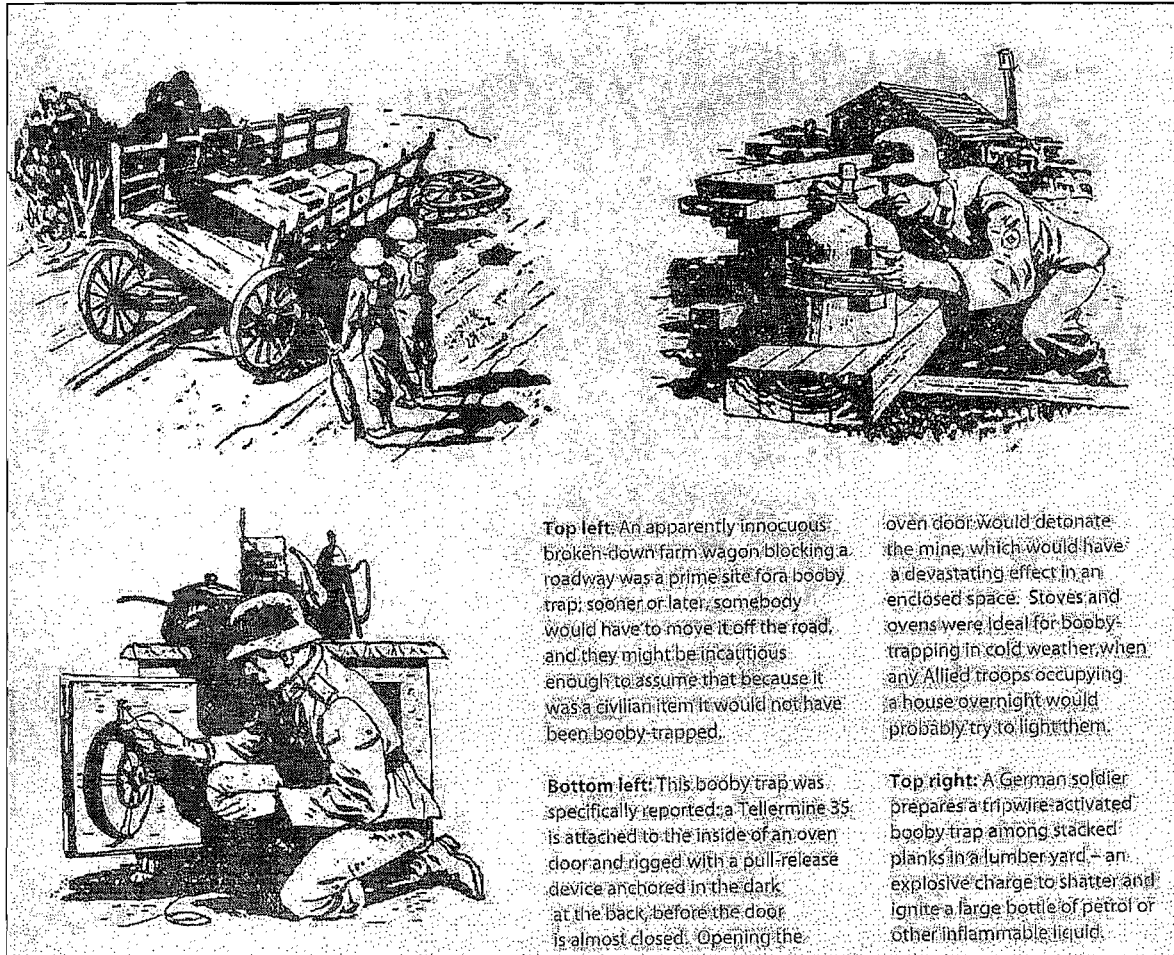


Figure 15. Royal Engineers Working on an Improvised Electrically Initiated Mine

Source: Mike Croll, *The History of Landmines*, (Great Britain: Pen and Sword Books Ltd)

Appendix H.

World War II German IED Placement Techniques



Top left: An apparently innocuous broken-down farm wagon blocking a roadway was a prime site for a booby trap; sooner or later, somebody would have to move it off the road, and they might be incautious enough to assume that because it was a civilian item it would not have been booby-trapped.

Bottom left: This booby trap was specifically reported: a Teller mine 35 is attached to the inside of an oven door and rigged with a pull-release device anchored in the dark at the back, before the door is almost closed. Opening the

oven door would detonate the mine, which would have a devastating effect in an enclosed space. Stoves and ovens were ideal for booby-trapping in cold weather, when any Allied troops occupying a house overnight would probably try to light them.

Top right: A German soldier prepares a tripwire-activated booby trap among stacked planks in a lumber yard – an explosive charge to shatter and ignite a large bottle of petrol or other inflammable liquid.

Figure 16. German IED Placement Techniques of WWII

Source: Gordon Rottman, *World War II Axis Booby Traps and Sabotage Tactics*, (Oxford: Osprey Publishing, 2009)

Appendix I.

Example of a VC / NVA VOIED

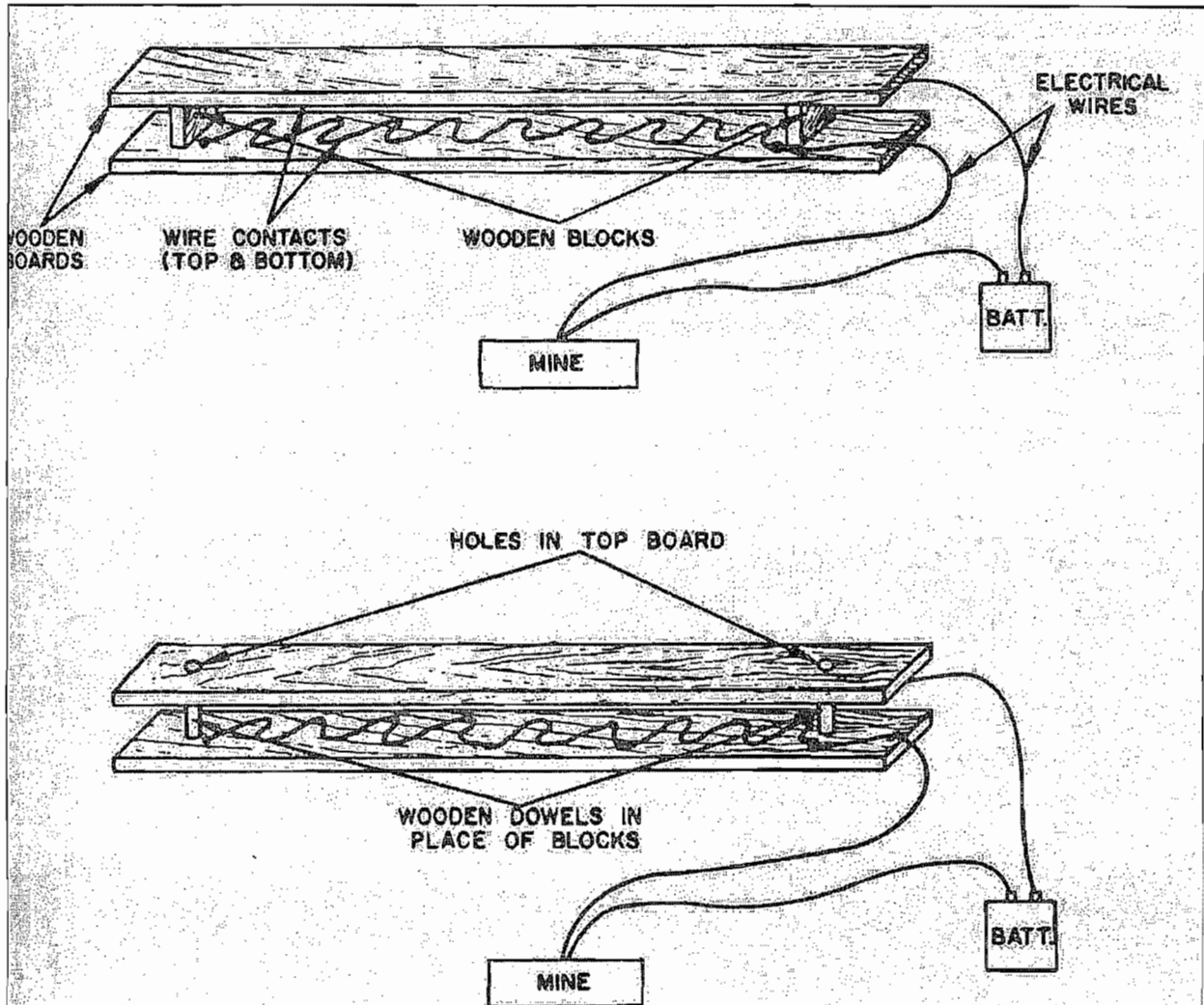


Figure 17. VC / NVA Pressure Plate Activated Electrically Initiated VOIED

Source: Headquarters United States Military Assistance Command Vietnam, VC-NVA *Employment of Mines and Booby Traps*, MACJ28 (San Francisco: Office of the Assistant Chief of Staff, Intelligence, June 1, 1967)

Appendix J
Iraqi IED statistics June 2003 – May 2010

	CF KIA	CF WIA	CAS	Effective Incidents	Ineffective Incidents	Found and Cleared	Total IED Incidents
Jun-03	0	35	35	12	10	0	22
Jul-03	7	81	88	32	32	0	64
Aug-03	8	142	150	70	76	0	146
Sep-03	7	172	179	86	107	0	193
Oct-03	15	240	255	110	182	2	294
Nov-03	35	179	214	95	149	259	503
Dec-03	24	241	265	76	93	191	360
Jan-04	21	107	128	56	100	251	407
Feb-04	11	154	165	58	93	253	404
Mar-04	25	188	213	92	120	269	481
Apr-04	34	292	326	145	201	306	652
May-04	31	330	361	156	298	292	746
Jun-04	17	216	233	106	250	275	631
Jul-04	29	299	328	135	246	248	629
Aug-04	29	323	352	167	292	282	746
Sep-04	44	369	413	158	321	295	774
Oct-04	35	362	397	170	425	368	958
Nov-04	40	418	458	211	503	422	1136
Dec-04	16	257	273	116	402	364	882
Jan-05	38	255	293	146	517	512	1175
Feb-05	29	242	271	131	445	427	1003
Mar-05	20	230	250	123	404	474	1001
Apr-05	30	367	397	174	505	464	1143
May-05	36	338	374	173	569	507	1249
Jun-05	38	322	360	159	511	452	1122
Jul-05	35	348	383	174	694	449	1277
Aug-05	44	382	426	194	720	498	1412
Sep-05	31	360	391	188	737	488	1413
Oct-05	52	405	457	209	812	662	1683

Figure 18. Iraqi IED Statistics June 2003 - October 2005

	CF KIA	CF WIA	CAS	Effective Incidents	Ineffective Incidents	Found and Cleared	Total IED Incidents
Nov-05	42	186	228	115	574	684	1373
Dec-05	40	259	299	132	627	712	1471
Jan-06	29	206	235	119	475	652	1246
Feb-06	36	207	243	112	548	759	1419
Mar-06	13	333	346	138	621	926	1685
Apr-06	57	283	340	158	683	939	1780
May-06	53	355	403	194	868	1008	2070
Jun-06	54	410	464	227	861	971	2059
Jul-06	30	383	413	210	971	1035	2216
Aug-06	47	384	431	190	1029	1054	2273
Sep-06	43	505	548	119	1097	1127	2301
Oct-06	72	486	558	228	970	1128	2326
Nov-06	35	358	413	179	919	1164	2262
Dec-06	69	401	470	241	1027	1133	2371
Jan-07	49	403	452	204	1078	1274	2556
Feb-07	45	375	420	166	871	1357	2394
Mar-07	59	369	448	179	927	1506	2612
Apr-07	76	416	492	192	834	1203	2229
May-07	98	497	595	254	935	1293	2482
Jun-07	83	572	655	242	1001	1345	2588
Jul-07	49	434	483	203	856	1078	2137
Aug-07	37	419	456	170	687	975	1832
Sep-07	29	262	291	115	586	878	1579
Oct-07	20	188	208	81	478	762	1321
Nov-07	22	136	158	72	299	684	1055
Dec-07	8	136	144	65	345	719	1129
Jan-08	22	184	206	73	325	857	1255
Feb-08	12	110	122	47	309	737	1093
Mar-08	28	192	220	91	318	766	1175

Figure 19. Iraqi IED Statistics November 2005 - March 2008

	CF KIA	CF WIA	CAS	Effective Incidents	Ineffective Incidents	Found and Cleared	Total IED Incidents
Apr-08	30	160	190	93	358	710	1161
May-08	14	105	119	51	316	534	901
Jun-08	16	121	137	47	184	371	602
Jul-08	2	72	74	36	178	343	557
Aug-08	2	52	59	25	197	335	557
Sep-08	4	43	47	22	173	324	519
Oct-08	2	47	49	22	103	288	413
Nov-08	2	59	61	29	75	313	417
Dec-08	3	35	38	21	98	267	386
Jan-09	3	59	62	22	77	259	358
Feb-09	7	39	46	18	105	233	356
Mar-09	0	20	20	7	99	229	335
Apr-09	12	52	64	20	90	231	343
May-09	10	55	65	21	106	197	324
Jun-09	8	59	67	26	87	149	262
Jul-09	0	21	21	9	75	87	171
Aug-09	3	25	28	11	99	122	232
Sep-09	4	18	22	11	94	116	221
Oct-09	1	23	24	12	77	110	199
Nov-09	0	10	10	7	54	83	149
Dec-09	0	22	22	9	57	69	135
Jan-10	1	15	16	10	59	89	158
Feb-10	0	30	30	12	45	68	125
Mar-10	1	17	18	13	61	84	158
Apr-10	3	28	31	11	84	73	168
May-10	1	37	38	15	47	60	122

Figure 20. Iraqi IED statistics April 2008 - May 2010

Source: http://csis.org/files/publication/100722_IED_INCIDENTS_IN_IRAQ.pdf

Appendix K.

Afghanistan IED Information

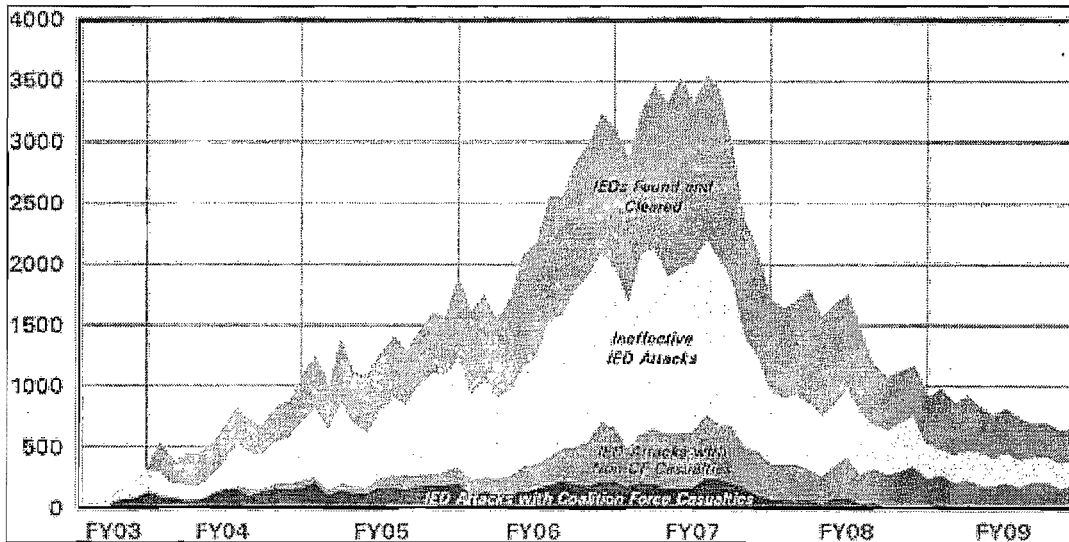


Figure 21. Afghanistan IED Statistics from FY 2003 – FY 2009

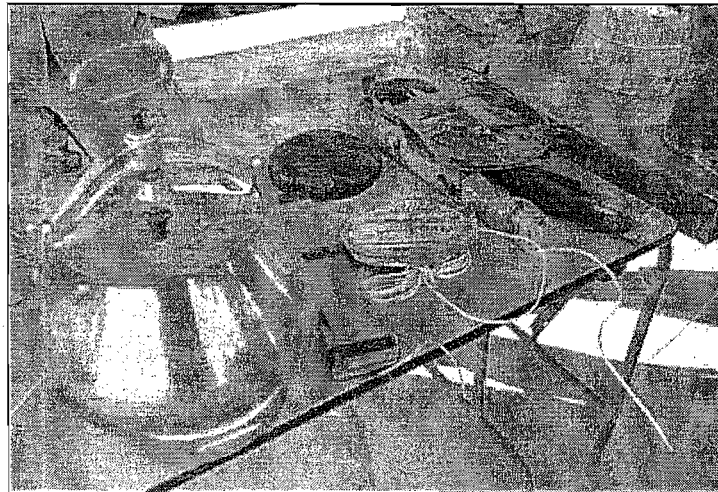


Figure 22. Afghanistan Pressure Cooker IED Container

Comment: This IED is very similar in design and function to the Confederate CWIED initiated IED from Fort Columbus in 1862 shown in Appendix D.

Figure 21 Source:

https://www.jieddo.dod.mil/content/docs/20090909_FULL_2009%20Annual%20Report_Unclassified_v1_lr.pdf

Figure 22 Source: <http://www.dvidshub.net/image/342997/ied-training-helps-marines-identify-threats>

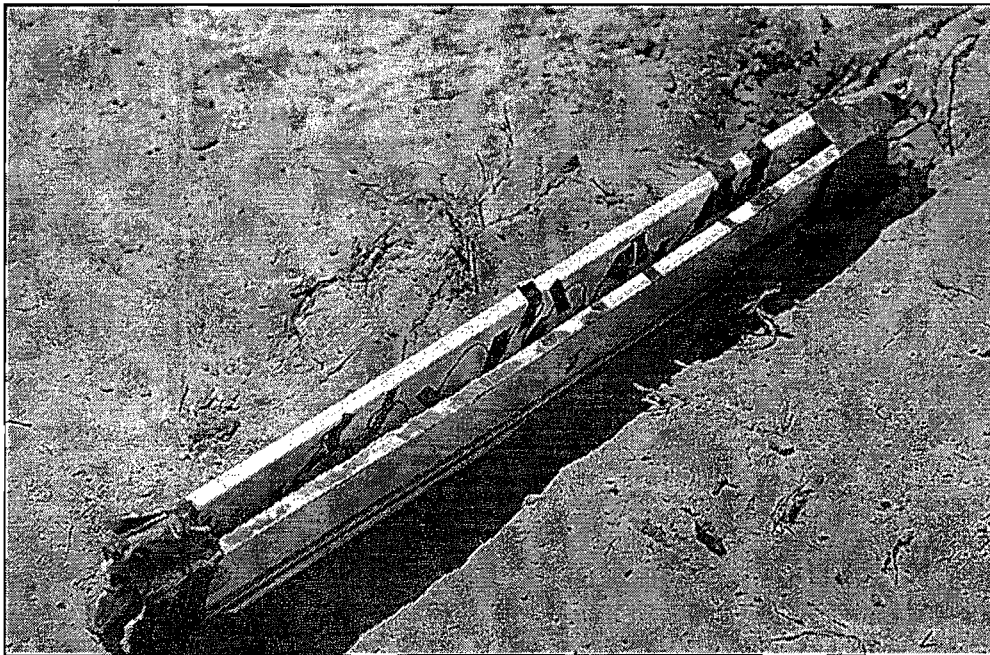


Figure 23. Afghanistan VOIED Pressure Plate

Comment: This VOIED Pressure Plate is identical in design and function to the VC/NVA VOIED Pressure Plate shown in Appendix I.

Figure 23 Source: <http://www.michaelyon-online.com/gurkha-ii.htm>

Appendix L

JIEDDO FY 2006 – FY 2010 Spending

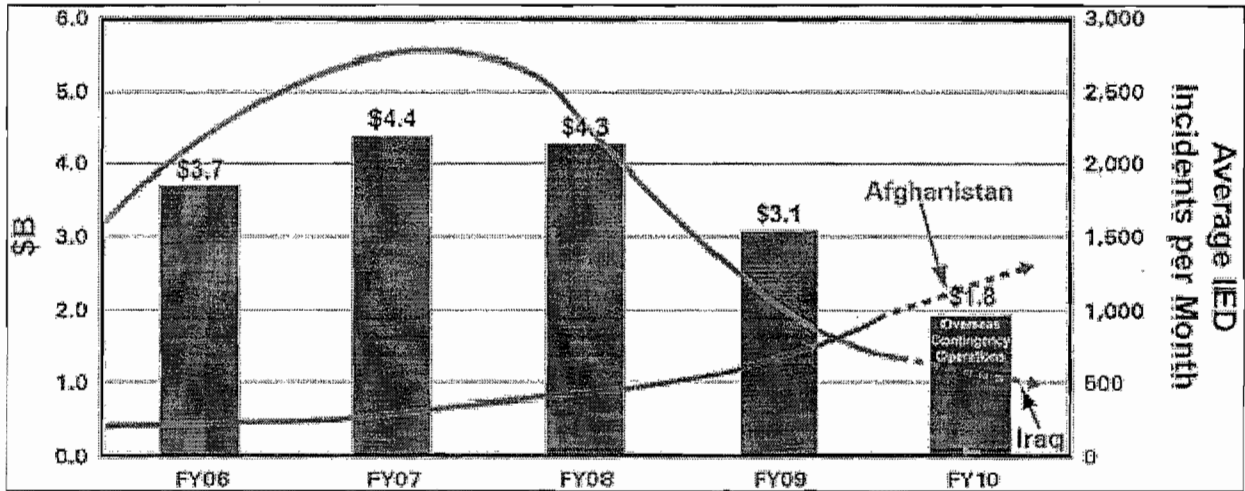


Figure 24. JIEDDO FY 2006 – FY 2010 CIED Spending

Source:

https://www.jieddo.dod.mil/content/docs/20090909_FULL_2009%20Annual%20Report_Unclassified_v1_lr.pdf

Appendix M

Placement of a Roadside Explosively Formed Penetrator (EFP)

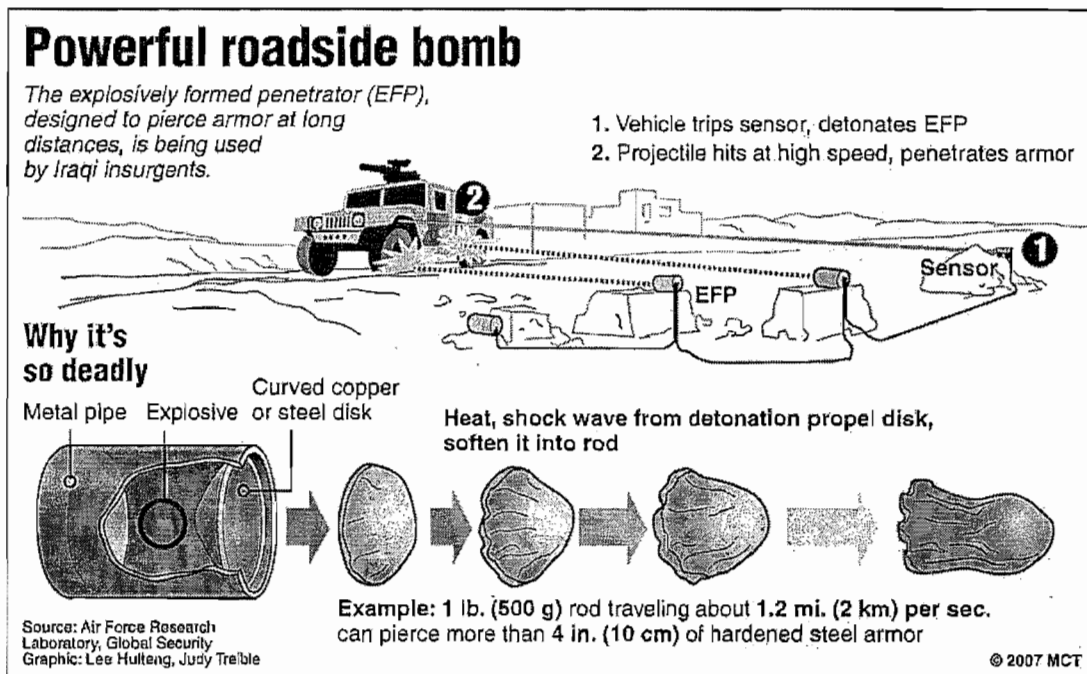


Figure 25. EFP Emplaced for a Roadside Attack

Source: <http://www.mcclatchydc.com/2007/11/15/21602/iran-stops-sending-a-deadly-weapon.html>



Figure 26. Armored Door of an Up Armored HMMWV Damaged by an EFP

Source: <http://www.wired.com/dangerroom/tag/mullah-menace/page/18>